Corona as a Standard for Measuring High Voltages—*Analysis of Rectification Losses in a Vapor Rectifier* and other engineering articles, together with the regular departments

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Electrical World

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Electrical World

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Death of Silvanus P. Thompson

A GREAT loss to the electrical profession and to the world is the passing of Silvanus Phillips Thompson, whose death is recorded in this issue. Professor Thompson exercised an influence in electrical engineering literature and teaching that commanded respect in all countries. He had many pupils, friends and admirers in America who can testify to his success as a teacher and a scholar. From being a teacher of physics, and especially of optics and electricity, he became a specialist in dynamo-electric design. At a very early date his text-books on that subject became classics. He was also one of the earliest protagonists of electrical power transmission, and by his earnest advocacy hastened its advent. As principal of the Finsbury Technical Institute since 1885, he came into direct personal contact with a large number of technical students who have carried his stimulating influence through their work to all parts of the world. As past-president of the Institution of Electrical Engineers and of the British Committee of the International Electrotechnical Commission he was recognized as the dean of the British electrical engineering profession.

But it was not merely in electricity that his writings were well known. He made many contributions to the history of science and philosophy. All his writings were characterized by a charming lucidity and directness of style. Many of his papers are delightful examples of scientific English. Moreover, he was not only a scholar but also an artist. He painted and loved works of art and had the soul of the artist associated with the mind of the scientist. Whole-hearted, earnest and devoted to the history and the development of electromagnetic science and art, our readers everywhere will venerate his memory as that of a great pioneer and a noble man.

Cheap Power and Industrial Development

WITH the growth of the central source of power is coming a realignment of industries around sources of power. It is naturally assumed that a water-power becomes the focus of a cluster of industries. In a somewhat similar way in large and small cities dependable power supply electrically distributed from steam plants is drawing manufacturing establishments. Whereas the central station manager in general must still seek industrial business and the millennium has not arrived when the isolated plant owner voluntarily sees the advantages of low-cost power from the central station, it is increasingly evident that the mountain is moving toward Mahomet and that industries are locating where market facilities and cheap power are both available. There are many interesting aspects in this development. Sudden and large demands for power induced by the war have forced developments in some sections. Factory owners have been willing to change the hours of work in order to get the demand off peak and so get a better rate. Industries, in other words, are fitting themselves to power supply, reversing the old and what seems to be the natural order.

Leadership in Technical Engineering Problems

THE annual convention of the A.I.E.E. to be held this month in Cleveland, coming as it does close upon the May convention of the N.E.L.A. calls attention to the distinctive activities of these two great parallel groups within the industry in both of which many individual electrical engineers hold membership. The purposes and scope of these two associations, which have done so much to advance the industry as a whole, have been and should continue to be distinctly different. The American Institute of Electrical Engineers is and should remain the professional and technical engineering body. Fundamentally the National Electric Light Association concerns itself rightly with the public policy, applied engineering and commercial problems of the industry.

Because electrical engineers have memberships in common in these two bodies, it naturally follows that there are overlapping problems, and occasionally papers have been presented before the Institute which indicate the chance for confusion as to the function of each of these great groups. Papers not strictly within the scope of its activities have found their way into the Institute proceedings.

The program of the annual meeting of the Institute at Cleveland, however, is an excellent example of opportunities for leadership of that body in the technical and professional work of the industry. The problems of high-voltage transmission, for example, including insulator design and voltage measurement, are waiting for solution so that further commercial advance will be possible. The papers by Dr. Whitehead and F. W. Peek, Jr., are notable contributions to the final solution of these problems and show admirably the function and purpose of the Institute in this field of electro-physics. Similarly in the other sessions subjects are presented which form groundwork for the wider application of the principles suggested in the fields of commercial development and operation.

Both the N.E.L.A. and the A.I.E.E. have reached the point in their development where the specialization of

their activities is natural. There is great work for each body to perform, the one in the field of applied engineering and commercial development, the other in the underlying problems of engineering analysis and research which have preceded and will continue to precede commercial application.

Three-Core Cables

OUR esteemed contemporary, *The Electrician*, recently published an abstract of an article by M. Hœchstaedter on three-core cables, in which it appears that certain electrical defects are pointed out and means suggested for avoiding them. A very common form of three-core cable employs three similar and equal insulated conductors, drapped with impregnated hemp between them in an enveloping cylindrical layer of insulation called the "girdle" insulation, which is finally incased in a waterproof leaden sheath. Owing to the lack of dielectric uniformity in this structure, the "girdle" insulation is apt to deteriorate when the working three-phase voltage exceeds a certain critical value, and then the last state of the cable is worse than the first.

The article recommends a return to the simple single-conductor type of construction, by suppressing the girdle insulating layer and covering each of the three individual insulated wires with a thin metallic envelop, with a plain hemp filling, and a cylindrical lead sheath over all. In such a structure, the insulation thickness on each conductor can be increased advantageously, with a resultant saving of insulation, weight and cost. The reasoning in the article is attractive and plausible. The outcome, however, suggests that it may be still better and more economical to separate the three conductors, and incase each in its own lead sheath, thus eliminating the internal metallic envelop, and the hemp filling, besides increasing the ease of handling and testing. The article is in this sense a plea for single-conductor lead cables.

Corona as a Measuring Standard

IT is only very recently that we have been able to arrive at definite quantitative notions concerning corona on wires, and now we have advanced so far in this direction that it is seriously and sensibly proposed to measure high voltages by their corona-forming criteria. Verily, *finis coronat opus*. The apparatus described by Dr. Whitehead in this week's issue, which has been designed for this purpose, consists essentially of an insulated metallic rod, mounted concentrically within a metallic cylinder, and provided with means for varying the air pressure within the cylinder until coronal formation can be detected on the rod. The theory of such a device is delightfully simple. Air, of a given density, breaks down electrically at a known electric intensity. If the rod is fitted into an enveloping cylinder only a little larger in diameter than the rod, any such initial breakdown in the air at the rod's surface causes a complete rupture, or electric discharge, between rod and envelop. That is, there is hardly any division in time or in fact between first breakdown and complete breakdown; because the first breakdown leaves the layer of air weaker than before. But if the envelop is much larger than the rod, or has, say, ten rod diameters, then, curiously enough, an initial breakdown of the air near the surface of the rod may strengthen the remainder of the insulating air wall. In such a case the initial breakdown may not precipitate discharge but will only establish corona.

With an enveloping-cylinder diameter ten times that of the inclosed rod, an enlargement of the rod to twice its diameter would diminish the air-wall thickness but would increase its dielectric strength, and this would continue, as the rod swelled in diameter, until the cylinder's internal diameter was only ϵ or 2.303 times the rod diameter, after which, further swelling of the rod would necessarily weaken the air wall. Consequently, when initial discharge occurs on a thin rod within a cylinder, it tends to ionize the immediately surrounding air and to make it partially conducting, which is akin, in effect, to causing the conducting rod to swell. But this increases the dielectric strength of the remaining air, and tends to stop further electric rupture. Unless, then, the voltage is greatly in excess, it will merely produce initial breakdown or corona, without producing complete rupture or short-circuit. The critical conditions for initial or coronal rupture are so sharply defined and so easily recognized, that the apparatus becomes a high-voltage voltmeter, with one sharp mark on the scale. By adjustably controlling the air pressure in the chamber, however, a fairly wide range of measurable voltages can be obtained, since the dielectric strength of air varies directly in proportion to the density.

It is certainly to be hoped that this instrument will be found as practicable as the description makes it appear. At very high voltages, sphere-gap measurers take up so much space that there is but little room for the rest of the apparatus in an ordinary chamber. The corona voltmeter seems to possess a considerable advantage from this standpoint and therefore gives promise of costing less in house rent.

The Inspection and Testing of Oil

DESPITE the old saying that oil and water will not mix, it is painfully evident in power transmission work that transformer oil does in one way or another take up water to an amount that is serious when insulation values are considered. Progressive companies, therefore, find it desirable and necessary to keep close track of the insulating properties of transformer oil, to test it with reasonable frequency and to treat it so that it may recover its insulating properties if deterioration is shown. A brief article elsewhere in this issue describes the system of caring for oil as worked out by the Georgia Railway & Power Company. It seems to be an excellent example of first-class practice and could be generally followed.

The oil is sampled at regular intervals—from indoor transformers every three months, from medium

voltage out-door transformers every two months, and from the 110,000-volt main transformers monthly. As will be seen, the scheme of testing delivers oil to the laboratory in exactly the same state that it is found in the transformers. If for any reason the insulating power of the oil is too low the oil in the transformer is treated in a filter press until it comes back to a 40,000-volt test. Particular care is taken to dry the filter papers in an electric oven before using, and to change them frequently if required. At present two filter stacks are in use for purifying the oil to decrease the time required, particularly on out-of-town work. By this means one man is able to complete filtering the oil for a bank of transformers in less time than was required for a single press worked in two shifts by two men. Incidentally, it is found that letting the oil settle over night gives better results than attempting to work the filter press a large part of the twenty-four hours. With careful attention to detail it is found that 600 gal. of oil in a transformer bank can be completely filtered and brought up to the 40,000-volt test in three days' working time, including the transportation of the filter press from the railroad, uncrating and setting it up, filtering the oil and then recrating the press and delivering the apparatus back to the station for shipment to the next job.

The method followed is an excellent example of a well-ordered system in dealing with a non-inviting job, but one which is absolutely necessary for obtaining the best service from a high-voltage system. Mere inspection of the transformer is too frequently neglected, particularly on large networks where the banks are widely scattered and in all sorts of situations. It is very easy for a trivial leak to start which may end in disaster if the condition of the transformers be not thoroughly watched. When one remembers that high-voltage systems are often subject to strains considerably in excess of the nominal voltage, it is evident that taking chances with the quality of the oil is very bad business. It is also evident that if proper care is to be taken of the transformers on a large system it must be done, not in a haphazard way but by some such well-ordered plan of regular attention which although it may take the time of one or two men of the operating force cannot be measured in value by the labor charge. These points are justly emphasized in the paper before us.

An Added Service to Readers

ANNOUNCEMENT has been made of the purchase of *Electrical Merchandise* and its incorporation in a new monthly journal, ELECTRICAL MERCHANDISING, to be issued monthly by the publishers of the ELECTRICAL WORLD. This announcement must seem a logical and natural development to our readers who have followed in the columns of the ELECTRICAL WORLD, the trend of the constantly widening market for electrical goods.

For forty years the ELECTRICAL WORLD has served the industry as the recorder and interpreter in the science and art of electrical engineering. Within that time has come a multiplication of activities within the industry as the products of the engineers and manufacturers have found wider and wider application. The editors of the ELECTRICAL WORLD, imbued with the ideals and traditions of a journal which has seriously endeavored to lead and mold opinion for the good of the industry, have met this demand from time to time by adding to its staff special contributors and editors who could correctly interpret not only the technical and engineering advance within the industry, but the broad problems of industrial and commercial activity which mesh with them.

In this development the ELECTRICAL WORLD has viewed these commercial problems of widening the application of electricity from the viewpoint of the executive, presenting the news of these developments so that these men in all branches of the industry, whether designing engineers, central station managers or heads of businesses in the jobbing and contracting fields, could build their own business by a knowledge of the advances in all lines in the industry as a whole. This the ELECTRICAL WORLD will continue to do.

But within the past five years there have grown up many problems of detailed trade and merchandising character which the lack of space alone, if no other reason, would prevent being properly considered in the weekly ELECTRICAL WORLD. Out of the detailed activities of the selling and merchandising side of manufacturing and distributing electrical products, with the jobbers, dealers and contractors, with new-business departments in central stations, has grown a sales group which bands together several thousand men within the industry as an "electrical trade." For this group, hitherto not served collectively by any journal, the publishers of the ELECTRICAL WORLD will supplement its service by the monthly journal for the electrical trade to be known as ELECTRICAL MERCHANDISING.

The editors will approach the trade problems of selling with the same seriousness of purpose which has been and will continue to be the ideal in making the weekly ELECTRICAL WORLD the interpreter of the professional engineering, public relations and industrial and commercial advance.

In inaugurating this broadened service, the editors wish to acknowledge their appreciation for the expressions of interest which have greeted the preliminary announcements of the publishers. Readers of the ELECTRICAL WORLD, in whose departments and in whose organizations the new journal will find its place, have corroborated the judgment of editors and publishers in stating that a journal is now needed which will extend the service of the ELECTRICAL WORLD in the detail of selling methods.

To crystallize the ideas of these readers and our own we shall present the editorial purposes of ELECTRICAL MERCHANDISING in a series of editorial announcements in later issues.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Dallas Negotiations Fail

Deadlock in Controversy Between the City of Dallas and the Street Railway and Electric Light Companies on Valuations, Earnings and City Control

All efforts to reach a compromise in the controversy between the city of Dallas and the street railway and electric light companies as to valuations, earnings and city control of rates and betterments are deadlocked, according to a formal statement just issued from the office of Mayor Henry D. Lindsley.

At the municipal election on April 4 the voters of Dallas adopted the valuations for these properties fixed by Edward Bemis in his report—$3,600,000 on the light plant of the Dallas Electric Light & Power Company and $3,500,000 on the various street railway systems—and indorsed model service-at-cost franchises to give the companies a net earning of 7 per cent on these valuations.

Since then negotiations have been under way between city officials and the companies owning the properties with a view to reaching a compromise. The utility companies insisted that their valuation figures of $4,400,000 for the electric light plant and $4,100,000 for the street railway properties east of Trinity River be taken as a basis, and on this the negotiations broke.

Immediately following the election on April 4, O. D. Young, vice-president of the General Electric Company, which owns certain securities of the various utility properties of Dallas, and which, it was announced, had secured an option on these properties from Stone & Webster, entered negotiations with the city of Dallas, looking to a reorganization of the various companies so as to meet the requirements of the city. Subsequently, J. F. Strickland and C. W. Hobson of Dallas were brought into the negotiation. It was explained that Mr. Strickland would undertake the organization of the electric light company and Mr. Hobson would undertake to organize the street railway, provided a mutually satisfactory conclusion could be reached on the franchises themselves.

In the course of the negotiations that followed the utility companies offered to yield on various points, but remained steadfast in the announcement that no valuation figures would be accepted except those fixed by the company, which are $1,400,000 in excess of those fixed by Mr. Bemis. Among the concessions offered by the utility companies were: (*a*) Expenditure of $5,000,000 on traction improvements in three years. (*b*) Building of two interurban lines in three years, each 30 miles long, to cost at least $2,500,000. (*c*) An 8-cent light rate immediately, and a 7-cent light rate one year from Nov. 1. (*d*) Promise that light rates would never go higher than at present, even under the service-at-cost systems. (*e*) Installation of the "London sliding scale" of light rates by which the company would be given a percentage of whatever saving might be effected by the introduction of economies. (*f*) A 1-cent light and power rate for factories.

During the negotiations it was understood by both parties that the franchises might be modified in matters of detail that would make them more workable, if it could be demonstrated that such changes were necessary, and that in all things other than the fundamental matters voted on by the people of Dallas, the attitude of the board of commissioners would be to adjust all differences in a spirit of fairness so that a conclusion would be reached.

According to a public statement by the Mayor, it seems that an agreement could be reached with regard to all points of differences, in so far as the city administration is concerned, and on a basis which could be recommended by the administration as fair and just to the people of Dallas and in conformity with their expressed wishes at the polls on April 4, except as to the valuations of the properties. Mayor Lindsley in his statement also said that at the last conference on June 3, after all other questions had been determined, the representatives of the public utilities still insisted that they would want a valuation of $4,400,000 for the electric light and power property and a valuation of $4,100,000 for the street railway property east of Trinity River.

Entertainment Features of A. I. E. E. Convention

The American Institute of Electrical Engineers will hold its thirty-third annual convention at the Hollenden Hotel, Cleveland, Ohio, during the last four days in this month. In addition to the technical program which was announced in these columns on May 27, a number of entertainment features have been planned.

A luncheon for the visting ladies will be given on June 27 at Halle Brothers' store, Euclid and East Twelfth Streets, followed by a shopping tour, in which many of the more important and distinctive stores will be visited. That evening a dinner-dance and reception will be given in the assembly room of the Hollenden Hotel. Immediately after dinner President J. J. Carty will introduce President-Elect Harold W. Buck. While the floor is being cleared a reception will be held in the north room for the president, president-elect and other officers of the institute. Dancing will continue until midnight.

An automobile trip through the parks, boulevards and residence districts of the east side of the city is planned for the next afternoon. In the evening a theater party at the Colonial Theater will be held for the ladies.

Thursday is the big recreation day. During the afternoon an outing will be held at Nela Park, at which athletic sports will be the predominating feature. There will be a ball game, tug-of-war and other contests for both the ladies and the men, with appropriate prizes for each event. Dinner will be served at the park, after which special cars will transport those attending to the Shaker Heights Country Club, where the presentation of the past-president's badge will take place, followed by dancing.

The last day will be given over entirely to a boat trip on Lake Erie. Put-in-Bay will be visited to give those interested an opportunity to see Perry's monument.

The usual tournament for the Mershon golf trophy will be held with preliminary rounds at the Shaker Heights Country Club and finals at Mayfield, said to be the third best course in the country. Arrangements are also being made to hold a tennis tournament.

Silvanus Thompson Dead

Noted English Physicist and Electrical Engineer Passes Away in London in His Sixty-sixth Year

Silvanus Phillips Thompson, noted electrical engineer and physicist and one of the most brilliant writers on electricity and magnetism in the English language, died in London on June 13, in his sixty-sixth year.

Silvanus Phillips Thompson was born at York, England, on June 19, 1851, and was educated at the Friends' School in that city. He subsequently studied at the Founders' College, and in 1869 graduated from London University with the degree of B.A. Having, however, a preference for science rather than literature, he took up the study of chemistry and physics at the Royal School of Mines, supplemented by visits to the University of Heidelberg, Germany, and other foreign institutions. In 1875 he graduated as a bachelor of science from the University of London, and three years later took the degree of doctor of science. In the meantime he had been acting as lecturer in physics in the then newly-established University College at Bristol, and in 1878 he was appointed professor of experimental physics in Bristol University College. From the time that he entered on his duties at Bristol, Professor Thompson made important contributions to contemporary science. His investigations ranged from the chromatic aberration of the eye to the form of coils in the tangent galvanometer. The curious optical illusion "strobic circles" was his discovery, and his application of the magnetic figures formed with iron filings to the illustration of electrodynamic relations and to the elucidation of the action of the dynamo-electric machine are well known. Professor Thompson also had the honor of having applied Clerk Maxwell's electro-magnetic theory of light to the explanation of the behavior of tourmaline crystals in their action upon polarized light, and he constructed electro-optic models of these crystals out of iron wire and glass. He also discovered the circumstance that the heavy metals, such as uranium and osmium, are better emitters of Roentgen rays than those of lighter atomic weight.

Professor Thompson was, probably, best known by his work among the applications of science than in the more recondite fields of abstract physics. His studies upon dynamo-electric machines are familiar to all electricians, and his Cantor lectures on the subject delivered in the autumn of 1883 established his reputation as a thinker and lecturer on the construction, theory and mode of working of dynamo-electric machines. Professor Thompson's "Elementary Lessons in Electricity and Magnetism" has been one of the most widely-read treatises on that subject, and has been printed in French, German, Italian, English and Polish editions. In 1884 he published his treatise on "Dynamo-electric Machinery," which has been translated into French and German. He also published several other works, including "The Electromagnet," "Polyphase Electric Currents and Motors," "Michael Faraday—His Life and Work," "Light, Visible and Invisible," and a translation of the Epistle of Peregrinus or "De Magnete." His latest work, "Life of Lord Kelvin," in two volumes, appeared in 1910.

Professor Thompson's electrical library is probably the most complete of any in private hands and is especially rich in early magnetic works. In 1885 he was elected to fill the chair of physics at the City and Guilds Technical College, Finsbury, where he was also principal. He was an able instructor on electrical subjects and made numerous contributions to the proceedings of the various technical societies in England. He was a fellow of the Royal Society, of the Royal Astronomical Society; a member of the Royal Academy of Sciences at Stockholm and of the American Philosophical Society; honorary M.D., of Koenigsberg; a past-president of the Institute of Electrical Engineers; past-president of the Physical Society; honorary vice-president of the Electrical Exhibition at Frankfort in 1891; delegate to the Electrical Congress of Chicago in 1893, past-president of the Roentgen Society, a delegate to the Italian

Congress of Electricians in 1899; past-president of the Optical Society, Illuminating Engineers Society, the Optical Conference in 1912, of the Settee of Odd Volumes Club, and one of the founders of the well-known Gilbert Club. He was an honorary member of the American Institute of Electrical Engineers.

I. E. S. Elects Officers

A meeting of the council of the Illuminating Engineering Society was held on June 8, in the general offices of the society, 29 West Thirty-ninth Street, New York. Reports were received from the chairmen of the various standing and special committees and from the representatives of the various sections of the society. A special report was received from the committee in charge of the annual convention and also the lecture course which is to be given at the University of Pennsylvania in the fall.

The annual election of officers resulted as follows: William J. Serrill, president; M. G. Lloyd, vice-president representing Chicago section; T. H. Piser, vice-president representing New England section; George S. Crampton, vice-president representing Philadelphia section; C. E. Clewell, general secretary; L. B. Marks, treasurer, and directors, C. A. Luther, D. McFarlan Moore, P. G. Nutting.

William J. Serrill, the newly-elected president, was born on Nov. 10, 1862, at Darby, Pa. He was graduated from the University of Pennsylvania in 1883 as a mechanical engineer. For two years he was employed with the Southwark Foundry & Machine Company in Philadelphia, and in June, 1885, he entered the employ of the United Gas Improvement Company of Philadelphia. Since that date he has served in various capacities in the engineering department of that company, and is now the engineer of appliances. In 1897, when the United Gas Improvement Company leased the Philadelphia Gas Works, Mr. Serrill assumed the position of engineer of distribution of the Philadelphia Gas Works, which he still holds. He served as chairman of the Philadelphia section of the I.E.S., 1910-1911, as vice-president, 1912-1913 and 1913-1914, and as treasurer of the society 1911-1912.

Water-Power Legislation

Synopsis of Proposed Laws Now Before Congress and Their Chief Points of Difference Outlined

There has been some confusion in the minds of many in the electrical industry as to the exact status of water-power legislation and more particularly on the functions of the four bills now under debate. For that reason we append herewith a review of the various measures together with their points of difference.

Water-powers in navigable streams are under the jurisdiction of the War Department and involve separate legislation from water-powers on the public domain. The government lands necessary to the development of water-power on non-navigable streams are under the control of the Departments of the Interior and of Agriculture. The Shields bill and the opposite Adamson bill originating respectively in the Senate and the House of Representatives have to do with water-powers on navigable streams while the Myers bill and its rival, the Ferris bill—the former the Senate bill and the latter the House of Representatives measure—deal with water-powers on the public domain. The issue is sharply defined, the electrical industry and banking interests leaning toward the Shields and Myers bills, while the Adamson and Ferris bills are favored by conservationists represented by Gifford Pinchot.

NAVIGABLE STREAM BILLS

The Shields bill passed the Senate on March 8, 1916, by a vote of 46 to 22 after five weeks' debate. The committee on interstate and foreign commerce of the House of Representatives, to whom the bill was referred, struck out all but the enacting clause and wrote a new bill known as the Adamson bill which, while retaining much of the structure and fundamental features of the Senate bill, differs from it in many particulars.

Both bills set forth the conditions and stipulations under which the United States shall give consent to the placing of dams and of appurtenant water-power structures in navigable streams. They have many provisions in common and at some places the language is identical. Their principal features are as follows:

Under the Shields bill permits to develop water-power in navigable streams are to be given by the Secretary of War. The bill sets forth at length the general terms and stipulations, and the Secretary of War is made the administrative authority to carry those terms and stipulations into effect. The Adamson bill sets forth terms and stipulations in detail, but requires the prospective power developer to secure a special act from Congress in each case.

The Shields bill provides for a permit period of fifty years, at any time after which the government may on two years' notice take over the property for itself or for a subsequent grantee by paying the fair value of the property not including the rights granted by the government. The Adamson bill contains provisions somewhat similar except that it provides that all rights shall cease at the end of fifty years.

Both the Shields and the Adamson bills provide for the protection of the public interests as follows: (*a*) The public service commissions of the States in which the water-power is located is given supervision of rates and service when the business is intrastate, and the same regulatory authority is conferred upon the Secretary of War when the business is interstate. (*b*) The Secretary of War is given authority to examine the books of the grantees and to require them to submit sworn statements of every detail of their business transactions. (*c*) Provision is made for cancellation of the grant in case the grantee fails to comply with the terms. (*d*) Unlawful trust or monopoly or restraint of trade is forbidden.

Both the Shields and the Adamson bills require the grantee (*a*) to install at his own expense locks, booms, sluices, signals or other structures in aid of navigation; (*b*) to furnish free of cost power for operation of the same; (*c*) to reimburse the United States for the cost of investigation and supervision incidental to the transaction; (*d*) to pay the United States for benefits accruing from headwater improvements established and maintained by the United States; (*e*) to pay the United States annual charges for the use of any government land used in power development.

The Shields bill provides that work under a permit must be begun within two years of the date thereof, and completed within such time as may be specified by the Secretary of War, while the Adamson bill provides that work must be begun within one year and be completed within five years thereafter. Both bills provide for diligent, orderly and reasonable development, and continuous operation of the water-power subject to market conditions.

Both bills provide that contracts for the sale of hydroelectric energy may be made for terms extending beyond the fifty-year period with the permission of the public service commission having jurisdiction and of the Secretary of War. The Adamson bill provides, however, that such contracts shall not extend more than twenty years beyond the fifty-year period.

The Adamson bill provides that not more than 50 per cent of the output of any plant shall be sold to one consumer, and that no power shall be sold through a distributing company without the consent of the Secretary of War.

The Adamson bill excludes "intangible values" in the fixing of rates or in the taking over of the property.

The Adamson bill reserves the right to Congress to alter, amend or repeal the act, and provides that the grantee shall be entitled to no indemnity for damages occasioned thereby. The Shields bill, on the other hand, reserves the right to alter, amend or repeal, but provides that if a grantee acting in pursuance of any grants made thereunder has expended his money and established property, such expenditures and property shall be considered as property rights of which the grantee shall not be deprived except by due process of law.

PUBLIC DOMAIN BILLS

The House of Representatives passed the Ferris public domain water-power bill on Dec. 8, 1915. The Senate public lands committee, to whom it was referred upon reaching the Senate, struck out all but the enacting clause and wrote a new bill known as the Myers bill.

The Myers bill with committee amendments submitted on March 14, 1916, is the same in principle as the Shields bill, while the Ferris bill passed by the House of Representatives on Jan. 8, 1916, is comparable with the Adamson bill.

The Ferris bill authorizes and empowers the Secretary of the Interior to lease lands of the United States for water-power purposes under such terms and conditions as he may prescribe. The Myers bill, on the other hand, authorizes and directs the Secretary of the Interior to issue leases to all who comply with the other terms of the law.

The term of lease under the Ferris bill is for not more than fifty years, at the end of which all rights lapse, unless a new lease is negotiated or unless the government takes over the property for itself or for another lessee. The Myers bill provides that if at the end of the fifty years the property is not taken over and no new lease negotiated, that it will continue in pos-

session of the lessee under the terms of the original lease, until the United States carries into effect such intentions as it may have with respect to the property.

The two bills are identical in providing that each lease shall provide for the diligent, orderly and reasonable development and continuous operation of the water-powers subject to market conditions, but the Ferris bill prohibits the sale to any one consumer of electrical energy in excess of 50 per cent of the total output. The Myers bill does not contain this restriction. The Ferris bill provides that the regulation of interstate service is conferred on the Secretary of the Interior, while the Myers bill vests that authority in the Interstate Commerce Commission.

The Ferris bill provides that there shall be no physical combination of plants or lines for the generation, distribution and use of power without the consent of the Secretary of the Interior.

The Ferris bill prohibits the delivery or sale of power to a distributing company in the manner already stated in connection with the Adamson bill, while the Myers bill makes no prohibition.

The Ferris bill provides that no lessee shall create any lien on any power project developed under the lease except that same be approved by the Secretary of the Interior, while the Myers bill provides that any successor in interest shall be subject to all the terms and conditions of the approval to the same extent as though he were the original lessee.

Both bills provide that after fifty years, upon not less than three years' notice, the United States shall have the right to take over the properties which may have been acquired by any lessee which are independent in whole or in part for their usefulness on a continuation of the lease. The Myers bill also provides that the government shall have the right to take over on mutual agreement a severable and complete unit of any such power system.

The Ferris bill provides that on the taking over of the property only the actual cost of lands and rights-of-way shall be paid and the reasonable value of the structures. The Myers bill, on the other hand, authorizes the payment of the fair or actual value of the whole property.

The Ferris bill excludes as elements of value on taking over, the value of the franchise, good-will, profits to be earned on pending contracts, and other intangible elements. The Myers bill excludes all of these except "other intangible elements."

The Ferris bill provides that in case the United States does not exercise its right to take over the properties, and does not renew the lease to the original lessee, the Secretary of the Interior may give the lease to a new lessee upon payment of the latter for the value of the properties as already set forth. The Myers bill provides that the original lessee in such a case shall have preference rights to renewal over and above any such new lessee upon such terms and conditions as the law and regulations then enforced shall authorize. The Myers bill also provides that in case the United States does not take over the properties, and does not renew the lease, then the old lease shall continue in existence until such time as the government takes decided action in the matter.

The Ferris bill gives the Secretary of the Interior full authority to fix the charges or rentals for use of government lands, while the Myers bill specifically provides that such rentals shall be based on the value of the land to be determined by the amount of horsepower development, and shall not exceed a sum of 25 cents per developed horsepower per annum.

The Ferris bill provides that where a State has not provided any regulatory body for the control of rates and services, the Secretary of the Interior shall exercise that function, while the Myers bill makes no such provision.

Portland Railway, Light and Power Valuation

In the largest valuation case in the West the Railroad Commission of Oregon has set the reproduction cost new of the property of the Portland Railway, Light & Power Company at a total of $45,337,000. Deducting depreciation, the value on the property was placed at slightly less than $41,000,000. This figure is in the neighborhood of $900,000 less than the company's figure for the same valuation.

From the company's original claim of $61,000,000 which included going value, water rights, etc., the commission eliminated about $6,250,000 of property, contending that it was non-operating. Also the commission eliminated the company's claim of $7,500,000 for going value on the contention that the company did not compute such value correctly. An opportunity, however, will be given to the company later to present additional testimony on going value.

On other minor reductions, including the elimination of $700,000 working capital out of the claim for $1,850,000, the commission found the money actually invested by present owners to be more than $50,000,000.

Attention was called by the commission to the depleted earnings of the company caused by the competition offered by the Northwestern Electric Company and by the jitneys.

Rate fixing will be the next to follow. Formal hearings on the valuation began on Jan. 25, 1915.

Leaders in the Electrical Art and Industry

By far the largest two bodies representative of the electrical arts and industries in this country are the American Institute of Electrical Engineers and the National Electric Light Association, the former coming into existence in the summer of 1884 and the latter being founded a few months later in the winter of 1885.

The ELECTRICAL WORLD prints herewith two groups of the portraits of men who have been honored with the presidencies of the two societies up to the present time. In both bodies the rule now prevails of an annual term of office, although at first this was not the practice. It will probably be admitted that in each of the organizations a wise choice has been made of those called to leadership.

In the National Electric Light Association the choice has naturally been limited to those engaged in the management and operation of central station properties, and while several of the presidents have been technical men with college education, the preference has been shown for those who by sheer weight of executive ability and driving power have reached the front rank.

In the Institute the range of selection has been much wider, and has included a large number of professors of physics and electrical engineering, inventors of distinction, presidents and vice-presidents of great corporations, operating engineers, consulting engineers, and journalists. There would seem little doubt that while the term of office is now so short as to allow no one man to carry very far any definite line of policy, the constant rotation in office has done much to enhance the vigor and activity of the two bodies, each man as he succeeds to the chair bringing with him new ideas, new motives, and new impulses which, while true to the given ideal of the organization, have broadened it out in various directions and have done much to create the remarkable success which both these societies now enjoy.

A proof of the above plate printed on glazed paper and suitable for framing may be obtained for 10 *cents, which covers cost of mailing*

A proof of the above plate printed on glazed paper and suitable for framing may be obtained for 10 cents, which covers cost of mailing

Concrete Cells for Circuit Breakers and Busbars

Arrangement of Switching Equipment to Minimize Investment and Methods of Casting Compartments in Place Employed by the Havana (Cuba) Electric Railway, Light & Power Company

By C. H. Sanderson

Electrical Engineer, Havana Electric Railway, Light & Power Company, Havana, Cuba

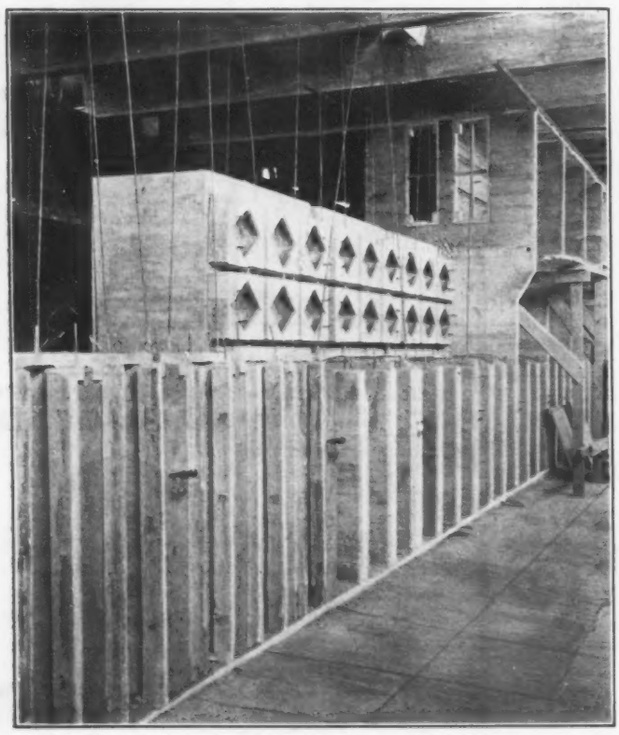
SINCE oil circuit breakers which will fulfill the modern requirements of high arc-rupturing capacity, large current-carrying ability and high flash-over strength are steadily growing more costly it is becoming increasingly important to devise means of keeping down the total expense of installing electrical equipment. One of the first steps that can be taken toward this end is to arrange the circuits in such a manner that the number of circuit breakers, buses, auxiliary connections and inclosing compartments shall be a minimum. With this done the cell structures should be designed so that they will not take up too much space, the electrical connections will be short and the structural work can be installed with the least expense, including material and labor.

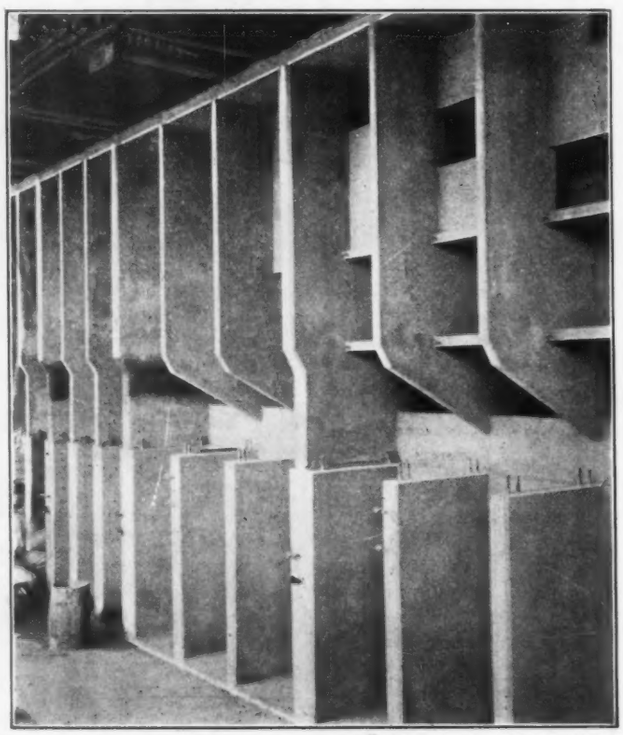
Good engineering practice requires duplication of buses and auxiliary switching apparatus for all main circuits to permit examination or repair of any circuit breaker, bus, auxiliary connections, or supporting structure, without interruption of service. Each generator and transformer bank should, therefore, have two circuit breakers, each with connections to one of two busbars. Each feeder, however, may be equipped with only one circuit breaker without foregoing the requirement mentioned provided each is connected with both buses. For instance, where two parallel feeders extend to a substation one may be employed while the other is out of service for cleaning or repair. Where only one feeder supplies a load center its circuit breaker may be isolated, if desired, and the circuit still be energized by connecting through disconnecting switches and jumpers to an adjacent feeder.

Electrical Layout That Minimizes Investment

An excellent example of the adaptation of these investment-saving principles is afforded by the Havana Electric Railway, Light & Power Company, in its new generating station, a cross-section and electrical layout of which are shown herewith. All 13,000-volt circuit breakers are arranged in groups of three, the first and third being used for feeders to substation while the middle one of each group is reserved as a spare for the other two. Later these spare circuit breakers may be used for other separate feeders, if conditions demand it, since each of the two feeders to each station is of sufficient capacity to carry the entire load and they thus constitute spares for each other. All 2200-volt feeders supply separate distribution centers of the light and power network. Their circuit breakers and corresponding connections to busbars are of sufficient capacity for 100 per cent overload or more, and the wiring is so arranged that any feeder may be energized from an adjacent circuit breaker by means of disconnecting switches when it is desired to isolate the circuit breaker and connections used under normal conditions.

In the station referred to there are thirty feeder circuit-breaker compartments each 5 ft. 2 in. long and 6 ft. wide. The feeder arrangement which was employed





FIGS. 1 AND 2—FRONT OF GENERATOR CIRCUIT BREAKER COMPARTMENTS DURING CONSTRUCTION AND READY FOR INSTALLATION OF APPARATUS

In the foreground of Fig. 1 the forms are shown in place; the middle part of the lower section has been completed and the forms for the second pour are in place while in the background all pours have been made and the top of the structure is being completed.

permitted using 155 lin. ft. less structure and 930 sq. ft. less floor space than would have been required if duplicate feeder circuit breakers were provided. When it is considered that to the cost of this structure would have been added the cost of additional apparatus, its installation, and additional floor space, had two feeder breakers been employed, it may readily be seen that from the viewpoint of both cost and space the single feeder circuit-breaker arrangement is a very attractive one. Furthermore, the feeder arrangement employed permitted the use of a single structure, especially adaptable to the long, narrow spaces usually provided for electrical equipment in modern power stations. Besides affording broad, well-lighted and well-ventilated aisles, the single structure permits the use of short cable runs between generators, transformer banks and circuit breakers, since the latter may be arranged to bring them comparatively near the apparatus they serve.

The structure consists of a central main wall, on one side of which are arranged the cells for the circuit breakers and the compartments for one set of busbars and connections. On the other side are cells for the second bus, its connections, and the incoming cables with their instrument transformers.

TABLE I—RATINGS OF THE CIRCUIT BREAKERS EMPLOYED

Circuit	Amperes	Maximum Voltage
13,000-volt feeders	300	15,000
H. T. side of 13,200/2200-volt transformers	600	15,000
2200-volt feeders	600	7,500
L. T. side of transformers	2,000	7,500
Generators	4,000	3,500

The same arrangement and dimensions of the cells were used for all circuit breakers except the 4000-amp. units. These require slightly wider cells than those mentioned. The generator and transformer circuits, having two circuit breakers each, are provided with inter-connecting or auxiliary bus compartments, as shown in the accompanying illustrations.

METHOD OF CONSTRUCTION

The main center walls and the large barrier walls between breakers were cast in place by the use of wooden molds, while all intermediate vertical barriers and all the horizontal shelves as well as the compartments surrounding the busbars were constructed of expanded metal plastered over with a cement mortar. The possibility of making use of expanded metal throughout to the exclusion of form work was carefully considered. However, largely on account of the considerable amount of structure to be built it was finally decided that greater economy could be obtained by using only a single set of forms for molding the entire length of the structure, since the other method would have required setting up the expanded metal for each unit and consequently involved considerable expense for labor and bracing material. Another advantage of the "cast-in-place" construction is that the center wall and main barriers present a substantial self-supporting frame upon which the remainder of the structure can be built with facility and dispatch. The expanded-metal skeleton work was attached to the main structure by means of metal rods, wires, or strips of expanded metal molded into the structure.

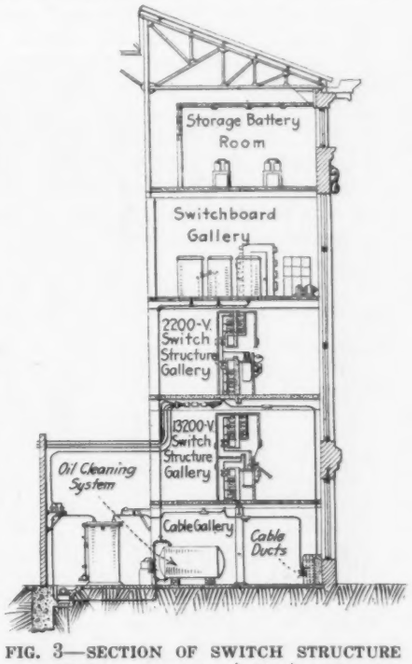


FIG. 3—SECTION OF SWITCH STRUCTURE GALLERY IN HAVANA (CUBA) STATION

SHAPE OF FORMS AND HOW THEY WERE USED

Because of their height the structures were poured in three sections thus requiring three sets or pairs of forms for each unit of structure. The lower section extended to the top of the circuit-breaker cells, and included all the heavy intermediate cell walls. The middle section extended to the lower edge of the selector-switch bases and included the openings in the main center wall through which all interconnections pass. The upper section included that part of the main wall to which the bus compartments are attached and provided the openings through the main barrier walls between the units of the structure for buses.

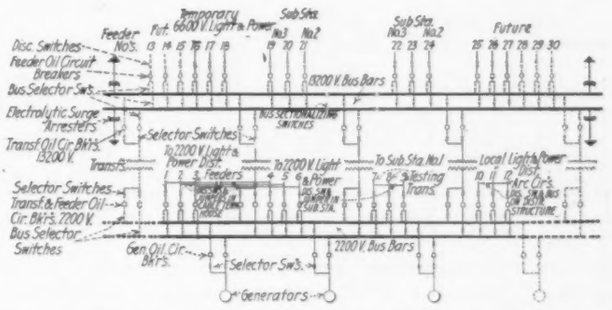
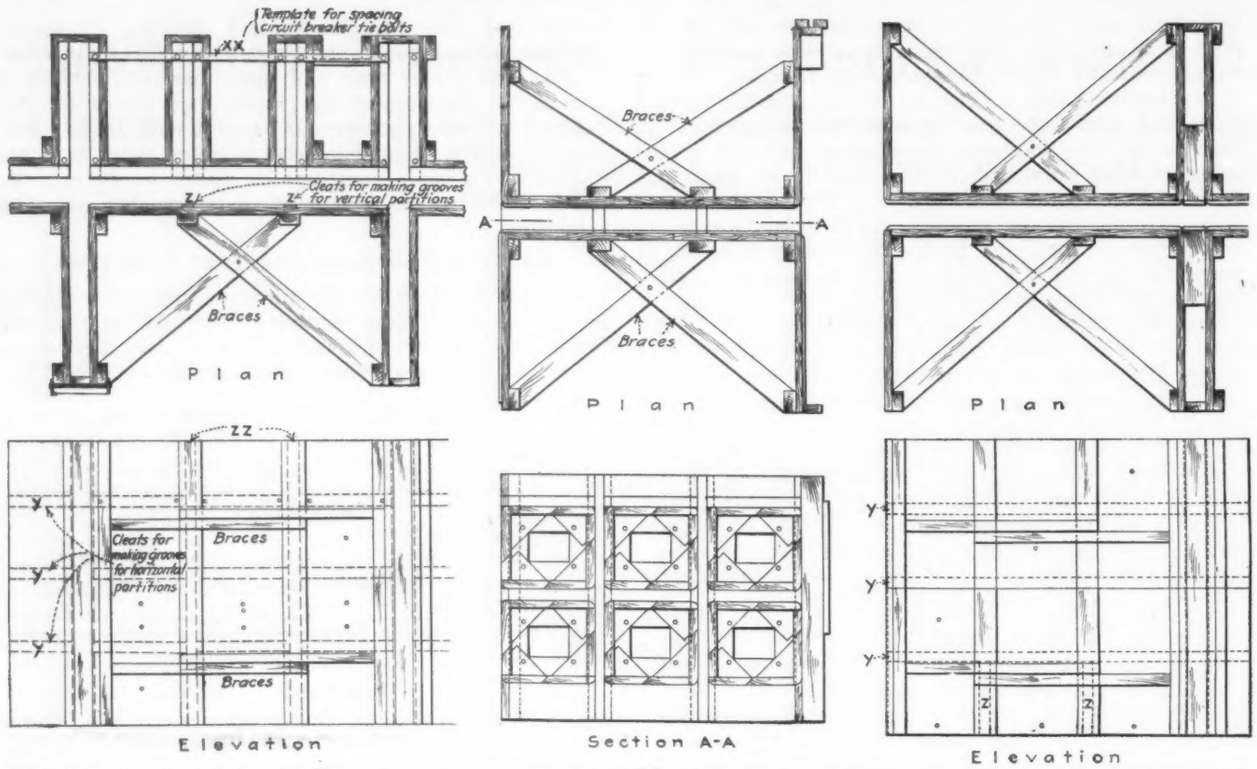


FIG. 4—MAIN SWITCHING CONNECTIONS INCLUDING SINGLE FEEDER CIRCUIT BREAKERS AND JUMPER DISCONNECTING SWITCHES

All forms were made from 1¼ in. by 6 in. tongued-and-grooved yellow pine dressed on both sides. It was found particularly necessary to instruct the lumber dealer that the tongues and grooves should be central so that the board surfaces would be flush when assembled. It was considered advisable to use 1¼-in. material instead of the more usual ⅞-in. stock to withstand repeated use and to minimize the amount of bracing which is usually employed to prevent the forms from bulging while the concrete was being tamped into place. The framing and bracing was made from 2-in. by 4-in. undressed yellow pine. To facilitate removing the forms after the cement had hardened they were made with ⅛ in. taper between parallel surfaces. The surface next to the concrete was coated with boiled linseed oil to reduce the penetration of moisture and to prevent adhesion of the concrete. Enough forms were made for the 2200-volt structure so that four feeder, one transformer, and one generator section could be set up at one time. The forms made for the 13,000-volt structure permitted setting up three feeder and two transformer sections at a time. The mounting bolts for disconnecting switches and insulating supports were secured to the forms and molded into place as the concrete was poured.

The lower-section forms were provided with wooden templates, *xx* (Fig. 5) for properly spacing the circuit-breaker tie bolts. Tapered horizontal cleats, *yy*, were provided on the transformer circuit-breaker forms for molding grooves in the main wall into which the auxiliary bus compartments were later set. On the lower forms used for feeder circuit breakers were provided tapered vertical cleats, *zz*, for molding grooves for the vertical intermediate barriers.



FIGS. 5, 6 AND 7—FORMS FOR MOLDING LOWER, MIDDLE AND UPPER SECTIONS RESPECTIVELY OF FEEDER OR TRANSFORMER CIRCUIT-BREAKER COMPARTMENTS

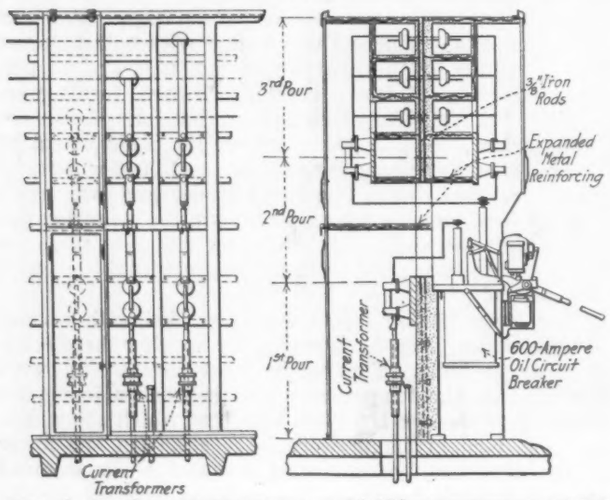
The middle-section forms were provided with rectangular, open-end, collapsible boxes for forming the openings for connections through the main center wall. These boxes were made in four parts so arranged that two opposite corner sections could be pulled toward the center, thus collapsing the box and permitting removal of the forms. Rectangular openings 8 in. by 6 in. were left in the form walls to permit handling them from either side. On the center lines between the boxes were provided many small holes for inserting wires, the ends of which were allowed to protrude 5 in. to 6 in. beyond the center wall for securing the horizontal-shelf and vertical-barrier reinforcing.

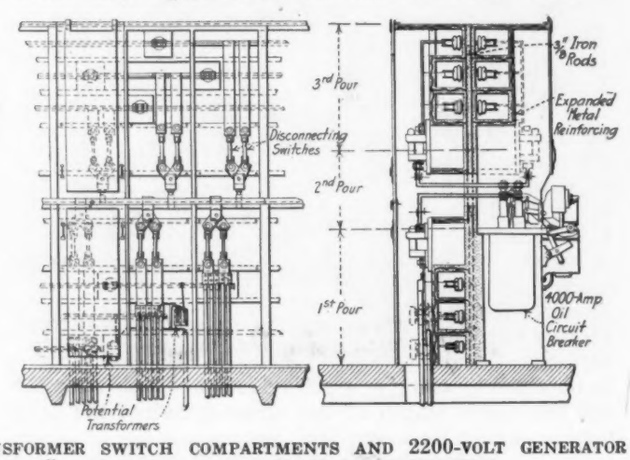
Because of the height of the structure and the proximity of its top to the ceiling, the upper-section forms were made in two parts to facilitate handling. Tapered vertical cleats, *zz*, were also employed on these forms, to provide grooves for building in the bus-supporting shelves. Holes for bus-supporting bolts were provided at the proper intervals. After the forms were set for the "pour" with all the hardware in place they were rigidly braced from each other and from the adjacent walls.

PLACING THE CONCRETE

The usual 1:2:4 mixture was used for the form work, clean sharp silica sand and 0.25-in. crushed limestone being employed. The mixture was poured in a very wet condition, tamped carefully at all points and given ample time to dry slowly. Lower "pours" were not permitted to dry completely, however, until the next higher section had been started. To insure a strong bond between sections all surfaces of set concrete were thoroughly moistened and roughened before being built upon.

The main wall was reinforced with ⅜-in. iron rods spaced about 6 in. apart and staggered. In placing these care was taken, however, not to surround magnetically the heavy electrical conductors. Strips of expanded metal were employed to reinforce the joints between the 4-in. intermediate walls and the 2-in. vertical barriers, where they merge above the circuit-breaker bases.





FIGS. 8 AND 9—CONSTRUCTION OF 13,200-VOLT FEEDER OR TRANSFORMER SWITCH COMPARTMENTS AND 2200-VOLT GENERATOR CIRCUIT-BREAKER CELLS, SHOWING HEIGHT OF "POURS" AND POSITION OF BARRIER REINFORCEMENT

Corona as a Standard for Measuring High Voltage

Discussion of Laws Governing Corona Formation — the Construction, Calibration and Operation of Corona Voltmeters with Ranges from 20,000 to 100,000 Volts

BY DR. J. B. WHITEHEAD
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THE word *corona* is the Latin for "crown," and has long been used by astronomers for describing the streamers and other light phenomena visible outside the black disk of the moon when it eclipses the sun. Electrical engineers have adopted the word to describe the luminous glow and spark streamers which appear about a bare round wire when subjected to high voltage. Electric corona is principally objectionable since it is the cause of a loss of energy, and therefore limits the value of voltage permissible in long-distance transmission. It may also burn or otherwise damage insulation and hence on this account also limits the use of high voltage. These facts were first brought into prominence about twenty years ago, and within the past ten or twelve years a great deal of study and experimenting have been directed toward the solution of the hitherto unknown laws of corona formation. For the most part the objects of these experiments have been the determination of the voltage at which corona begins and the law of the increase of energy loss above the corona voltage.

In this article the writer takes up only the phenomenon of the first appearance or start of the corona. The law governing the beginning of corona is now well established. The most important factors are the diameter of the wire and the value of the electric potential gradient at the surface of the wire. Other factors are the atmospheric temperature and pressure, and the condition of the surface of the wire as regards smoothness. The law as given in equation (1) applies only to clean, smooth wires. The critical or corona-forming voltage is independent of the moisture content of the air, is apparently the same for both alternating and continuous voltages, and is independent of the frequency within the commercial range. With alternating voltages, corona appears when the maximum or crest voltage reaches the critical value.

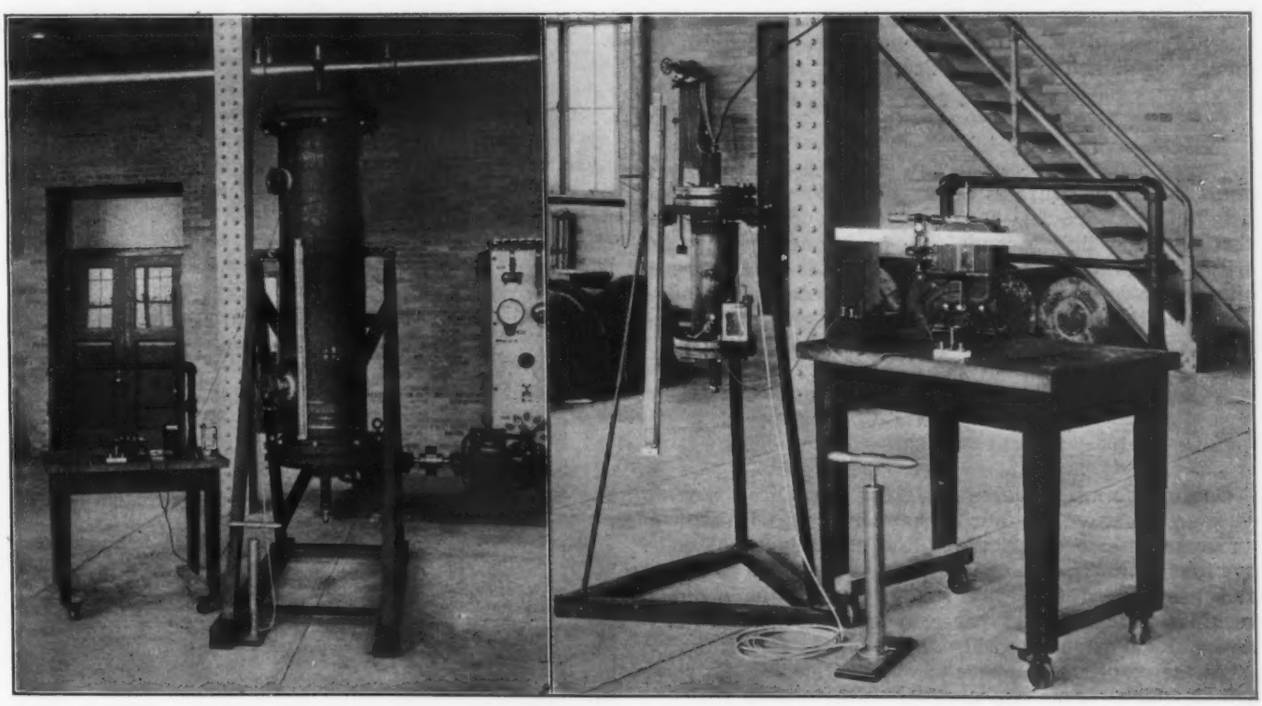
LAWS OF CORONA FORMATION

The law connecting the critical surface potential gradient, that is, the gradient at which corona first appears, and the diameter of the wire is:

$$E = 32 + \frac{13.4}{\sqrt{d}} \qquad (1)$$

In this equation E is in kilovolts per centimeter and d is the diameter of the wire in centimeters. This is purely an experimental law and its form is due to features of the structure of the air which are not yet well understood. Many observers agree as to the form of the law, although there are small differences among the values of the numerical constants as given by different observers.

The electric intensity or potential gradient at the surface of a wire subjected to high voltage depends not only on the value of the voltage but also on the distance and shape of the conductor forming the opposite side of the circuit. In only a few simple cases is it possible to calculate rigidly the surface intensity corresponding to a given voltage. One of the commonest cases is that of two parallel wires. If the distance between wires is great compared with their diameter, the surface intensity may be calculated in terms of the wire diameter distance between wires and the voltage. Corona then appears on the wires at a voltage which gives a surface



FIGS. 1 AND 2—TWO CORONA VOLTMETERS—THE ONE AT THE LEFT HAS A RANGE UP TO 100,000 VOLTS AND THE ONE AT THE RIGHT UP TO 50,000 VOLTS

intensity called for by equation (1). The relation thus formed leads to the expressions for corona-forming voltages on transmission lines as given by F. W. Peek, Jr., and others. In the case of parallel wires observed values of corona voltage may differ widely from calculated values, due to the proximity of conductors.

The only arrangement which is free from disturbance due to surrounding objects, and which gives a perfectly uniform electric field around the wire in all circumstances, is that in which the wire lies along the axis of an outer cylinder forming the opposite side of the circuit. In this case if V is the voltage in kilovolts be-

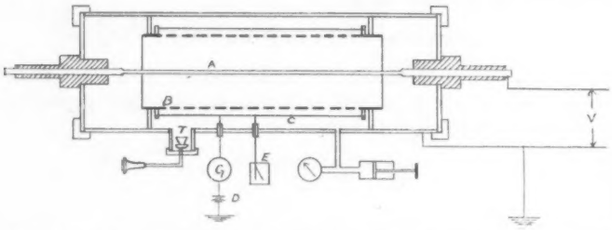


FIG. 3—CONNECTIONS AND AUXILIARIES OF CORONA VOLTMETER

tween wire and cylinder, and R and r are the radii of the outer and inner cylinder in centimeters, then

$$E = \frac{V}{r \log_e \frac{R}{r}}; \qquad (2)$$

Substituting this in formula (1) we have

$$V_c = 32\left(1 + \frac{.296}{\sqrt{r}}\right) \cdot r \log_e \frac{R}{r}; \qquad (3)$$

Where V_c is therefore the critical corona forming voltage in kilovolts, for a wire of radius r cm., in an outer cylinder of radius R cm.

In the foregoing it has been assumed that the temperature and pressure of the atmosphere are constant at so-called standard conditions. If the pressure is increased or the temperature decreased, higher values of voltage are required to start corona, and *vice versa*. In other words, the greater the density of the air, the higher the corona voltage for a given wire. The influence of both temperature and pressure is included in one factor known as the density factor.

$$\delta = \frac{3.92\, p}{273 + t} \qquad (4)$$

in which p is the pressure in centimeters of mercury and t the temperature in Centigrade degrees; $\delta = 1$, for $p = 76$ and $t = 25$ deg. C. Experiment and theory agree that δ enters into formula (3) as follows, giving the critical value of voltage V_c in kilovolts at which corona appears on a wire of radius r in a cylinder of R under any conditions of temperature and pressure as represented by the corresponding values of δ:

$$V_c = 32\left(\delta + .296\sqrt{\frac{\delta}{r}}\right) \cdot r \log_e \frac{R}{r}; \qquad (5)$$

Constancy of Corona Voltage

One of the most interesting facts in connection with corona formation is the extreme constancy with which, under successive observations, the above value of voltage repeats itself. The appearance of corona is so sharp and pronounced that the voltage can be determined within a fraction of 1 per cent and the observations repeated as often as desired. Table I, for example, gives the results of a series of observations of the voltage at which corona appears, the voltage being read on a low-tension coil of the transformer, and the presence of corona observed by four different methods. This constancy also obtains from day to day when the readings are corrected for temperature and pressure.

This constancy has led to the suggestion that the corona might be used for the measurement of high voltage. Up to this time, however, no use has been made of this suggestion, largely because the corona can only be seen in the dark and particularly because it seemed that it would be necessary to use different sizes of wire for different voltages. To be generally useful a high-voltage measuring instrument should permit reading in the open daylight and should have a reasonably wide range with a minimum of adjustment. In what follows an instrument is described, using the appearance of corona as indicator and a measure of voltage.

The Corona Voltmeter

The instrument consists of a single wire or rod accurately centered on the axis of an outer cylinder. The voltage is applied between them and the outer cylinder is usually grounded. The voltage is determined by the presence of corona on the central wire in accordance with formula (5), and the instrument is provided with several devices for indicating the first appearance of corona. A wide range of voltage is obtained by inclosing both wire and cylinder in an outer, airtight cylinder, provided with suitable insulating bushings, in which the pressure may be varied and both temperature and pressure observed. This provides a means of varying δ, and consequently V_c, the corona-forming voltage, through a wide range. All of the other factors of equation (5) are constant, and so the calibration curve may either be calculated from the equation or may be obtained by direct comparison with existing standards. It should be especially noted that the corona voltage is determined absolutely from the dimensions of the instrument and the density of the air. The instrument, therefore, is an absolute standard of voltage.

Indicators for Presence of Corona

As indicators of the presence of corona which may be used in the open and under all conditions, three methods have been devised—the electroscope, the galvanometer and the telephone. The use of both electroscope and galvanometer depends on the fact that the air in the

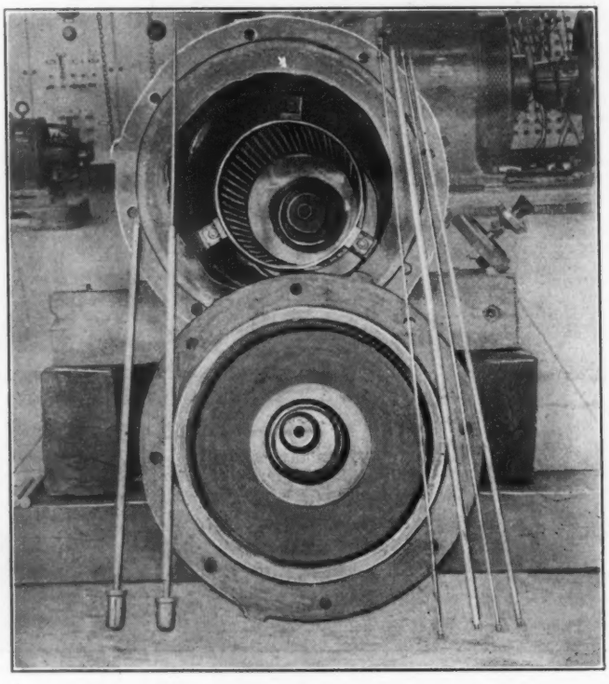


FIG. 4—INTERIOR OF 100,000-VOLT CORONA VOLTMETER

neighborhood of the corona is made highly conducting, that is, becomes ionized. This conductivity or ionization, moreover, appears and disappears sharply with the appearance and disappearance of corona. An electroscope near a wire on which corona forms discharges sharply at the instant corona appears. In order to use this property as a detector of corona it is only necessary to arrange the proximity of the electroscope so that it does not disturb the electric field about the wire.

In Fig. 2 the wire A on which corona is formed is centered on the axis of the cylinder B. Voltage is applied between A and B, with B connected to ground. B is also drilled through over its entire surface with small holes close together. C is a thin metal cylinder outside of and of diameter very little greater than that of B and insulated from B. G is a galvanometer connected to C, and also to earth through the battery D. E is an electroscope connected to C, or better, to a smaller electrode fitting into an opening in C. When corona appears on A, the ionization of the air immediately spreads to the space between B and C, and puts it in a conducting state. The charge on the electroscope, therefore, leaks to ground and the circuit of the battery D is closed through the galvanometer G which, therefore, is deflected. The degree of conductivity imparted to the air is small as compared with that of familiar conducting substances, but it is quite sufficient to give the indications described on galvanometers and electroscopes of only moderate sensitivity. The appearance of visual corona and the indications of the instruments are simultaneous.

In the open the corona gives a slight hissing sound, which, however, is quite audible in a quiet place. If the ends of a corona tube are closed, or if the whole tube is inclosed as indicated in Fig. 3, the sound is gathered and confined, and becomes quite loud if the ear is placed at an opening in the inclosed cylinder. The very first presence of corona is readily detected in this way. If a telephone transmitter, T, is placed in a side tube as shown, the sound of the beginning of corona is quite loud in a receiver connected to the transmitter, and so may be detected at a distance. This is the simplest and most convenient method of observation.

All of the methods described for detecting corona may be used when the pressure in the outer cylinder is raised or lowered above or below that of atmosphere. The visual method is also possible in a darkened room through glass windows suitably placed. The close agreement of the four methods is shown in Table I.

TWO CORONA VOLTMETERS

Two instruments making use of the above principles, and for ranges 100,000 and 50,000 volts respectively, have been constructed and are shown in Figs. 2, 1 and 4. In Fig. 4 attempt is made to show the inside cylinder with holes drilled over its entire surface, the cylindrical electrode close to this cylinder, the insulating bushings, etc. The larger instrument is 238 cm. long over all, the diameter of the outer and inner cylinders being 45 cm. and 30.7 cm. respectively. This was the first instrument constructed, and liberal allowance was made for convenient access to all working parts during experiments. As a consequence it is unnecessarily large. The instrument in Fig. 2 was designed with an aim to reduce the dimensions to the least values consistent with reliable operation. Its range is 20,000 to 50,000 volts, its length over all 76 cm., and its diameter over end flanges 24 cm. Its weight is 75 lb.

As already stated, the range of the instrument is accomplished by varying the pressure in the containing cylinder. This is done with an ordinary hand air and vacuum pump, and the pressure is read on a suitable air gage. Mercury gages are shown in the photographs. The temperature inside the tube is also read through a window. The connections to electroscope, galvanometer and telephone are brought out through airtight sulphur bushings. The ends of the outer cylinder are closed with plate-glass disks held between flanges and made tight with soft rubber gaskets. The central conductor on which corona is formed is introduced through porcelain insulators cemented into the glass disks. The central conductor may be readily removed and arrangements are provided for accurately centering it.

The range of the instrument is limited in two ways—by the pressure of the air in the tube and by the insulation of the leading-in bushings. The former can scarcely be considered a limitation as a range of pressure between 30 cm. of mercury below and 60 cm. above atmosphere, with the same central conductor, will give a range of 20,000 to 50,000 volts in the smaller, and a corresponding range in the larger instrument. Higher pressures, and thus a wider range of voltage are easily possible. It appears from present experience that the limit of voltage is first reached at the leading-in bushings. In other words, the pressure may be easily raised so that corona voltage will be above the breakdown voltage of the leading-in bushings. This means that the size of the corona voltmeter will be approximately determined by that of a terminal bushing to withstand the maximum voltage to be measured.

TABLE I—COMPARISON OF METHODS OF DETECTING CORONA—0.95 CM. ROD IN 30.7 CM. TUBE

	Tertiary Coil Volts
Electroscope	55.5, 55.5, 55.5, 55.4, 55.5
Galvanometer	55.6, 55.6, 55.6, 55.6, 55.6
Telephone	55.6, 55.6, 55.6, 55.6, 55.6
Visual	55.6, 55.6

The range of the instrument may also be widened by changing the diameter of the corona forming the central conductor. This is manifestly inconvenient, and offers no advantages over the method of variation of pressure. In the instruments described the entire range is obtainable with a single rod in each, the smaller 0.396 cm. and the larger 0.635 cm. in diameter.

CALIBRATION AND OPERATION

One of the most important features of the corona voltmeter is the fact that its calibration between voltage and air density is absolutely fixed by its dimensions. The properties of air do not change, and, in fact, equations (1) and (5), in the light of extensive experiment corroborating them, now appear to indicate a readily available physical constant not heretofore appreciated. The corona voltmeter possesses, therefore, an inherent calibration dependent only on the observation of the air density δ. The calibration curve may be plotted between maximum voltage V_c and δ. Since, however, δ includes values of both temperature and pressure, and since it is impracticable to control the temperature, it is better to plot several curves between V_c, the corona voltage, and p, the pressure in the table, each curve pertaining to a particular temperature. It is a simple matter to plot such a family of curves embracing the range of temperature occurring in common usage. This plan obviates the necessity of calculating δ. The pressure may then be adjusted by a hand pressure or vacuum pump to a value corresponding to any desired voltage as taken from the curve for the temperature which happens to prevail in the tube at the time of observation. Obviously, instead of the curves, a table may be used in which for each temperature a series of pres-

sures is given, each pressure corresponding to a particular value of voltage. Fig. 5 gives a set of curves of calibration of the smaller instrument described; intermediate curves may be readily drawn.

It is well known that present methods of measuring high voltage are unsatisfactory and uncertain. The standard sphere-gap of the American Institute of Electrical Engineers gives widely-varying results in the hands of different observers and in different surroundings. Perhaps the most reliable method is the measurement of the voltage on a low-tension tertiary coil or by means of a potential transformer. This method is elaborate, not suited to general use, and does not measure the maximum value of the voltage.

The observations which have been made with the two instruments described have been taken using the second, or transformer ratio, method of checking the high-tension voltage as indicated by the corona. The transformer used is of 10-kva. capacity and ratio 110/220 to 100,000 volts, 20-100 cycles, the observations throughout being taken at 60 cycles. The transformer has a tertiary coil on which the voltage was read; the ratio of transformation and all other constants are known. The ratio of maximum to effective value was determined by oscillograms of the tertiary coil voltage over the whole range. The temperature inside the tubes was read directly and the pressure by a mercury gage, as shown in the photographs. In this way many observations have been taken. In the smaller instrument the range was between 20,000 and 51,000 volts, corresponding to a range of pressure between 30 cm. and 130 cm., and in the larger between 55,000 and 100,000 volts with a pressure range 64 cm. to 136 cm.

The results of one series on each instrument are plotted in the curves of Fig. 6, the lower curve pertaining to the smaller instrument. The solid curves show the calculated or absolute calibration, and the crosses the values indicated by the tertiary coil reading of voltages and crest factor, and the ratio of transformation.

The agreement is seen to be very close on the smaller instrument, but with the larger there is a divergence which increases with the voltage. The explanation lies in the leakage reactance of the high-tension winding of the transformer, and the leading charging current of the combined capacities of the high-tension winding and the larger voltmeter. Owing to its small capacity and the low voltage, the charging current with the smaller instrument was very small and there is no appreciable rise in voltage in the high-tension winding except at the highest values where the effect begins to appear. With the larger instrument, however, the

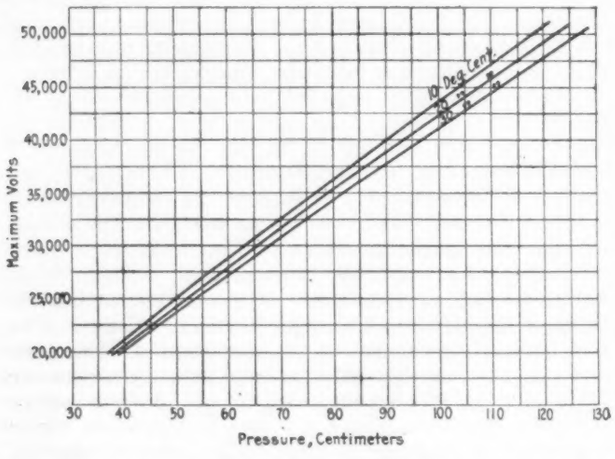


FIG. 5—CALIBRATION CURVES FOR 50,000-VOLT CORONA VOLTMETER

charging current of the high-tension winding becomes appreciable and the connection of the corona voltmeter increases the primary current from 2.9 to 4.3 amp., the watt input remaining constant, showing that it has considerable capacity. The high-tension winding of the transformer is known to have large leakage reactance and consequently the rise of voltage in this

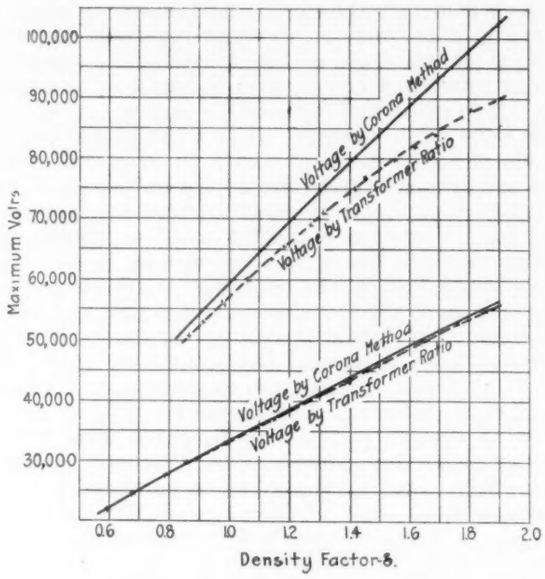


FIG. 6—TEST OF TRANSFORMER RATIO WITH CORONA VOLTMETER

winding results in higher voltage at its terminals than is indicated by the primary voltage and ratio of transformation. This rise of voltage is not transmitted to the tertiary coil, since in this transformer it was found that this coil was not subject to the same leakage field as the high-tension secondary, a necessary condition if a tertiary coil is to give true indication of high-tension voltage.

The curves therefore indicate how the corona voltmeter may be used to detect errors in ratios of transformation, rather than an agreement between the absolute calibration of the corona and that indicated by existing standards. The corona is a better standard than a tertiary coil and voltmeter. It is obvious that if it is preferred to rely on some other standard rather than accept the absolute calibration, the corona voltmeter may be readily compared with such standard. As already pointed out, however, there are at present no reliable methods available for measuring high alternating voltage. The corona under proper conditions is so constant and so readily adjusted for different voltages that only brief experience with it shows its many advantages over present standard methods. Its reliability, permanence and convenience, however, are in no way impaired by referring its readings to some other standard.

The limits of this article will not permit description of a number of other experiments looking to the determination of the length of service of one central wire without recleaning, the best material for this wire, the minimum dimensions of the entire instrument for a given range, etc. If the voltage is not carried well above that required to start corona, and if corona is not allowed to continue on the wire, observations may be repeated practically indefinitely. Corona has been held on a rod forty minutes without appreciable lowering of critical voltage. Nickel-plated and silver-plated surfaces appear to be the most permanent, although their advantage in this respect is not very great.

It would appear that the corona tube as a standard of high voltage has several advantages over the sphere-gap. (1) In the matter of constancy of indication, readings may be repeated by the same observer practically any number of times to a degree of constancy limited only by that of circuit conditions and the degree of accuracy obtainable on the best type of indicating instrument at the low-voltage terminals. The observations of different observers, taken under different conditions and in different places are, moreover, in very close agreement. (2) The adjustment of the corona tube for different values of voltage is by means of air pressure, no modification of the structure of the instrument being required. The adjustment of the sphere-gap means a change in the space separation of the spheres. Moreover, for the same range of voltage the range of pressure in centimeters is about ten times that of space separation of the sphere-gap, thus permitting a greater degree of accuracy in setting. (3) The corona tube has an absolute calibration which is free from disturbance by surrounding objects. Attempts have been made to ascribe an absolute calibration to the sphere-gap, but authorities do not agree as to this calibration. Furthermore, as is known, the indications of the sphere-gap are subject to serious disturbances by surrounding objects. (4) The corona tube is simple in construction and can be set up quickly in any laboratory. This cannot be said for the sphere-gap.

As an instrument of measurement the corona voltmeter has also other noticeable advantages. (1) In the matters of constancy, permanence and freedom from outside influence, the same advantages hold as described. (2) Great simplicity of adjustment and reading, a hand air pump, a thermometer and a pressure gage being the only requirements. (3) Four alternative methods for checking the readings. (4) Independence of frequency and wave form throughout a wide range. (5) No series resistance necessary, and no spark-over, nor arc nor other energy consumption occurs in the use of the instrument. (6) Readily constructed in portable form.

The author extends his thanks to M. W. Pullen for his valued assistance in the experiments conducted at the Laboratory of Electrical Engineering, Johns Hopkins University.

An Analysis of Vapor-Rectifier Losses

Mathematical Demonstration Showing Relations Between Bulb Losses and Impressed Wave Form, Anode Current and Frequency

BY DR. WILLIAM TSCHUDY

AS is well known, the process of rectification in a vapor rectifier takes place in the bulb in case of a glass rectifier or in the tank in case of a large-capacity rectifier. The bulb, tank or rectification losses, as they may be termed, represent a loss of electrical energy used to generate the necessary heat for vaporizing a part of the mercury in the bulb or in the tank. It has been customary to consider the voltage drop in the arc as a "loss," constant and independent of the anode current. This drop was measured by various investigators and was found to be in the neighborhood of 15 volts. From the fact that the voltage drop is considered constant and independent of the anode current the erroneous idea prevails that the voltage drop is identical with the loss in the arc and that this loss is constant. The voltage drop in the arc has been confused with the arc loss, the loss of electrical energy in the arc. For the design of rectifiers, especially those of large outputs, it is naturally essential to form some definite ideas regarding composition of these losses and their dependence upon the anode current and the measurement of the losses.

Although the above facts were recorded several years ago in articles[1] by the present writer, yet it seems worth while to present them again in view of the confusion in ideas which still exists concerning the loss phenomena in mercury vapor apparatus. In Fig. 1 i_2 represents the instantaneous and I_2 the effective value of the anode current, e_2 the instantaneous and E_2 the effective value of the anode voltage. The bulb losses per anode $(W_g \div 2)$ can be measured in the manner indicated in Fig. 1. If i_2 and e_2 are known, the bulb losses per anode can be represented by the equation:

$$\frac{W_g}{2} = \frac{1}{T}\int_o^T i_2 e_2 dt \qquad (1)$$

T is the time for one period.

If the anode current and anode voltage curve are given, the equations for i_2 and e_2 can be determined by analyzing the curves.

[1] *Bulletin* des Schweizerischen Elektrotech. Vereins, 1912; *Elektrische Kraftbetriebe und Bahnen*, 1913.

It is well known that every periodic function, such as the anode voltage curve, can be represented by an equation of the form:

$$e_2 = E_o + E_1 \sin 2\pi ft + E_2 \sin 4\pi ft + \ldots . \qquad (2)$$

wherein E_o is a constant, E_1, E_2, etc., are the different amplitudes of the higher harmonics, and f is the number of cycles per second. Introducing the symbol of summation, equation (2) becomes:

$$e_2 = E_o + \Sigma E_k (k2\pi ft) \qquad (3)$$
$$k = 1, 2, 3, \text{ etc.}$$

A curve which is symmetrical to neither the X nor the Y line (Fig. 2) can be represented by an equation having the form shown above. The instantaneous value e_2 is composed of an undirectional-current component E_o and an alternating-current component $\Sigma E_k k2\pi ft$. $(k = 1, 2, 3, \text{etc.})$.

The instantaneous value i_2 has therefore a similar equation because the anode current curve is symmetrical to neither the X nor the Y line. The only difference consists in the difference of phase between i_2 and e_2, and hence the equation is

$$i_2 = I_o + I_1 \sin(2\pi ft + \alpha_1) + I_2 \sin(4\pi ft + \alpha_2) + \ldots . \qquad (4)$$

When written in the general form, equation (4) becomes

$$i_2 = I_o + \Sigma I_k (k2\pi ft - \alpha_k) \qquad (5)$$
$$k = 1, 2, 3, \text{ etc.}$$

The difference of phase between i_2 and e_2 is mathematically expressed in the way that the alternating-current component of e_2 is represented by

$$\Sigma E_k (k2\pi ft), \qquad (k = 1, 2, 3, \text{ etc.})$$

while the alternating-current component of i_2 has to be written in the form

$$\Sigma I_k (k2\pi ft - \alpha_k). \qquad (k = 1, 2, 3, \text{ etc.})$$

The values of (3) and (5) introduced in equation (1) give the following result:

$$\frac{W_g}{2} = \frac{1}{T}\int_o^T [I_o + \Sigma I_k \sin(k2\pi f - \alpha_k)] [E_o + \Sigma E_k \sin k2\pi ft] dt \qquad (6)$$

$k = 1, 2, 3, \text{ etc.}$

Equation (6) can be simplified as follows:

$$\frac{W_g}{2} = I_0E_0 + \Sigma\frac{I_kE_k}{2}\cos\alpha_k. \qquad (k = 1, 2, 3, \text{ etc.})$$

$$\frac{W_g}{2} = I_0E_0 + \frac{I_1E_1}{2}\cos\alpha_1 + \frac{I_2E_2}{2}\cos\alpha_2 + \ldots\ldots \qquad (7)$$

From equation (7) the conclusions are drawn that:

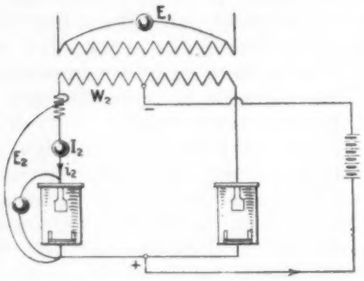


FIG. 1—CONNECTIONS FOR METHOD OF DETERMINING THE BULB-LOSSES PER ANODE

(a) The bulb losses per anode ($W_g \div 2$) are composed of a direct-current component I_0E_0 and an alternating-current component

$$\Sigma\frac{I_kE_k}{2}\cos\alpha_k. \qquad (k = 1, 2, 3, \text{etc.})$$

(b) In measuring the losses ($W_g \div 2$) the same steps must be taken as in measuring an alternating-current effect, which means that a wattmeter must be used.

(c) The direct-current component can be determined by measuring the average values of the anode current and the anode voltage, and hence instruments indicating average values (such as Weston instruments) must be used.

(d) The alternating-current component can be determined by the difference between the wattmeter and voltmeter-ammeter readings.

(e) It would be wrong to determine ($W_g \div 2$) by multiplying the anode current I_2 with the anode voltage E_2.

(f) There is a difference in the composition of the loss in the arc of a direct-current mercury-vapor lamp and a rectifier. In the first case the loss can be determined by multiplying the anode current by the anode voltage; in the second case the loss must be measured by a wattmeter.

(g) There is a marked difference between the electrical characteristics of a direct-current mercury-vapor lamp and a rectifier.

Equation (7) may be utilized for determining the anode losses in the following manner:

When i_2 and e_2 have been ascertained by analysis, as, for instance:

$$i_2 = 3.58 + 5.17\sin(2\pi ft - 31°29') + 1.59\sin(4\pi ft + \pi + 17°33') + 0.374\sin(6\pi ft - 38°32') + 0.108\sin(8\pi ft + \pi - 31°55') + 0.183\sin(10\pi ft + 43°59') + 0.045\sin(12\pi ft - 19°23') + 0.105\sin(14\pi ft + \pi - 5°19') + 0.068\sin(16\pi ft + \pi + 72°08') + 0.0581\sin(18\pi ft + 33°42') + 0.017\sin(20\pi ft + \pi + 20°23') + 0.013\sin(22\pi ft - 52°35'),$$

and

$$e_2 = 115.1 + 221.2\sin(2\pi ft + \pi - 11°51') + 136.5\sin(4\pi ft + \pi + 70°20') + 50.0\sin(6\pi ft - 5°48') + 34.3\sin(8\pi ft + \pi - 20°57') + 38.72\sin(10\pi ft + \pi + 87°33') + 24.9\sin(12\pi ft + 27°18) + 19.45\sin(14\pi ft + \pi - 9°18') + 20.15\sin(16\pi ft - 67°05') + 13.6\sin(18\pi ft + 62°30') + 17.28\sin(20\pi ft + \pi - 9°06') + 17.2\sin(22\pi ft - 40°32'),$$

then the bulb losses per anode can be calculated by means of equation (7), as shown by the following calculations:

$$\frac{W_g}{2} = 3.58\times 115.1 + \frac{5.17\times 221.2}{2}\cos(\pi + 19°38') + \frac{1.595\times 136.5}{2}\cos 52°47' + \frac{0.374\times 50}{2}\cos 32°44' + \frac{0.108\times 34.3}{2}\cos 10°58' + \frac{0.183\times 38.72}{2}\cos 43°34' + \frac{0.045\times 24.9}{2}\cos 46°41' + \frac{0.1050\times 19.45}{2}\cos 3°59' + \frac{0.068\times 20.15}{2}\cos 40°47' + \frac{0.0581\times 13.6}{2}\cos 28°49' + \frac{0.0174\times 17.28}{2}\cos 11°17' + \frac{0.0137\times 17.2}{2}\cos 12°03'.$$

1. $I_0\times E_0 = 411.3$
2. $\frac{I_2\times E_2}{2}\cos\alpha_2 = 65.8$
3. $\frac{I_3\times E_3}{2}\cos\alpha_3 = 7.7$
4. $\frac{I_4\times E_4}{2}\cos\alpha_4 = 1.82$
5. $\frac{I_5\times E_5}{2}\cos\alpha_5 = 2.56$
6. $\frac{I_6\times E_6}{2}\cos\alpha_6 = 0.38$
7. $\frac{I_7\times E_7}{2}\cos\alpha_7 = 1.02$
8. $\frac{I_8\times E_8}{2}\cos\alpha_8 = 0.52$
9. $\frac{I_9\times E_9}{2}\cos\alpha_9 = 0.35$
10. $\frac{I_{10}\times E_{10}}{2}\cos\alpha_{10} = 0.15$
11. $\frac{I_{11}\times E_{11}}{2}\cos\alpha_{11} = 0.12$

491.72

12. $\frac{I_1\times E_1}{2}\cos\alpha_1 = -539.20$

$$\frac{W_g}{2} = (-539.20 + 491.72) = -47.48 \text{ watts.}$$

From the above analysis one concludes that:

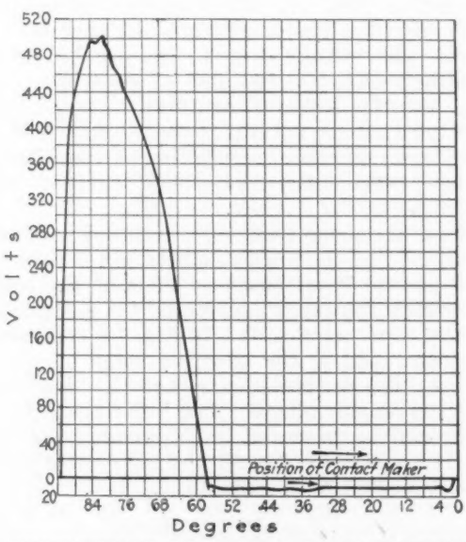


FIG. 2—ANODE VOLTAGE CURVE FOR A CONSTANT PRIMARY VOLTAGE E_1 OF 110, 50 CYCLES AND NON-INDUCTIVE LOAD

(h) A change in the wave-form influences the bulb losses because the first, second and third harmonics affect the bulb losses.

The direct-current component I_0E_0 in this case is 411.3 watts, the alternating-current component roughly —459 watts.

The effective value of I_2 can be calculated by means of the formula:

$$I_2 = \sqrt{\frac{I_0^2 + I_1^2 + I_2^2 + I_3^2 + I_4^2 + \dots}{2}} = 5.27 \text{ amp.}^2,$$

and in the same way the effective value of E_2 is

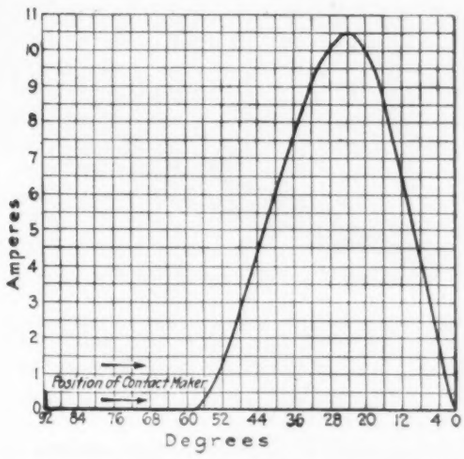


FIG. 3—ANODE CURRENT CURVE FOR THE SAME CONDITIONS AS IN FIG. 2

$$E_2 = \sqrt{\frac{E_0^2 + E_1^2 + E_2^2 + E_3^2 + E_4^2}{2}} = 215 \text{ volts.}^2$$

The product I_2 and E_2 would be 1130, but it would clearly be erroneous to find the bulb losses ($W_g \div 2$) in this way.

(k) It is well to introduce a factor to show the relation between the direct-current component and the bulb losses ($W_g \div 2$), for instance:

$$l = \frac{I_0E_0}{I_0E_0 + \frac{\Sigma I_k \Sigma E_k}{2} \cos \alpha_k} = \frac{I_0E_0}{\frac{W_g}{2}} = \frac{411.3}{48} = 8.58.$$

This factor could be termed the relation factor or the power-relation factor because it characterizes the composition of the bulb losses.

It was mentioned that the wave-form has an influence upon the bulb losses. A further demonstration for this statement may be given by some test results.[3] I used three different generators—one with a flat-topped emf. curve, one with a peaked emf. curve, and a third one with almost a sine curve. For the three different generators the bulb losses were measured for the same output, same number of cycles, same primary voltage as follows: In the first case 152.5 watts, in the second case 212 watts, and in the third case 138 watts. The difference between the maximum (212) and the minimum losses (135) is 53.7 per cent. It is evident that the efficiency varies correspondingly. If the anode-current and the anode-voltage curve are given, the bulb losses may be determined in the following way by means of equation (1):

Divide the length T (see Fig. 3) into a number of equal parts, preferably twelve, and determine the products i_2, e_2 from the curves obtained by an oscillograph or contact maker; then plot the instantaneous power values i_2e_2 (see Fig. 4) and determine the area with a planimeter or by other means. In this case the area is 418.5 sq. cm., the length T is 44.5 cm., and if 2 mm. correspond to 1 watt, then the rectification losses per anode are:

$$\frac{W_g}{2} = \frac{418.5}{44.5 \times 0.2} = 47.3 \text{ watts.}$$

Or, written in a general form:

$$\frac{W_g}{2} = \frac{A \text{ in cm.}^2}{T \text{ in cm.} \times a} \qquad (8)$$

A is the area, T the time for one period, a the number of watts corresponding to 1 cm. In most cases the in-

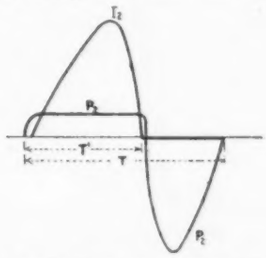


FIG. 4—RELATIVE POSITIONS OF ANODE-VOLTAGE AND ANODE-CURRENT CURVES

stantaneous values e_2 are constant during the time where the instantaneous values i_2 are larger than zero; e_2 begins to vary almost at that time where the values i_2 are practically zero (see Fig. 4), and hence we obtain from equation:

$$\frac{W_g}{2} = \frac{1}{T} \int_0^T e_2 i_2 dt$$

a modification

$$\frac{W_g}{2} = \frac{e_2}{T} \int_0^T i_2 dt.$$

e_2 is the average value of the instantaneous values during the time $0 — T'$ (see Fig. 4). Therefore

$$\frac{W_g}{2} = e_2 \times I_0. \qquad (9)$$

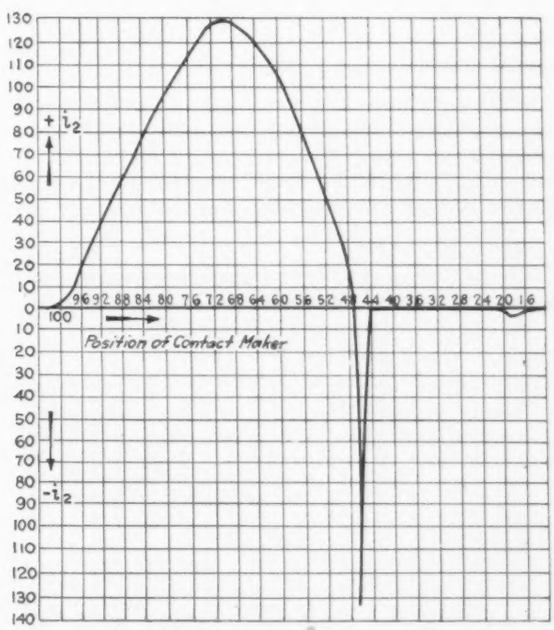


FIG. 5—INSTANTANEOUS POWER VALUES OF THE BULB-LOSSES PER ANODE

I_0 is the average value and was found by analysis. $I_0 = 3.58$. The average value of e_2 is 13.5, and hence

$$\frac{W_g}{2} = 13.5 \times 3.58 = 48.3 \text{ watts.}$$

An important relation is that between the anode-current and the bulb losses. Fig. 7 shows the anode voltage E_2 and the losses ($W_g \div 2$) as functions of the anode current I_2 for a constant voltage. $E_1 = 110$ volts

[2] The symbols on the right-hand side of the equation represent amplitude values.
[3] *Archiv für Elektrotechnik*, 1913.

and a normal frequency of fifty cycles. These curves show that with increasing load—that is, an increasing anode current I_2—there is a rapid rise of $(W_g \div 2)$, while E_2 is only slightly decreased (about 3 per cent).

I found that the relation between the anode current and bulb losses is as follows:

$$(W_g \div 2) = AI_2^2 + BI_2, \qquad (10)$$

where A and B are two constants found by the method

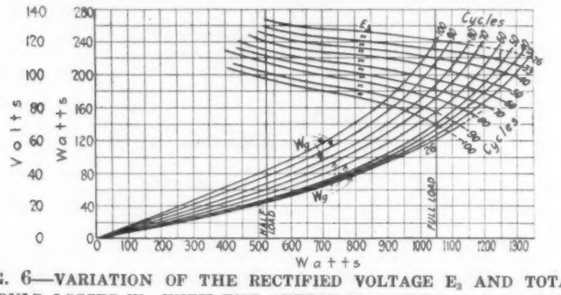


FIG. 6—VARIATION OF THE RECTIFIED VOLTAGE E_2 AND TOTAL BULB LOSSES W_g WITH THE OUTPUT FOR CONSTANT PRIMARY VOLTAGE $E_1 = 110$ VOLTS AND VARIABLE FREQUENCY

of least squares to be $A = 0.650$ and $B = 5.68$, hence

$$(W_g \div 2) = 0.650\, I_2^2 + 5.68\, I_2.$$

If the primary voltage E_1 is held constant but the frequency is changed, then the bulb losses are different for the same output. It was found that for E_1 of 110 volts, frequency of twenty-six, and an output of 1050 watts,

VALUES OF A AND B

Frequency	A	B	Frequency	A	B
26	0.523	6.25	70	0.410	7.41
33	0.587	6.60	80	0.348	8.75
40	0.741	5.78	90	0.225	9.57
50	0.650	5.68	100	0.208	9.90
60	0.465	7.06			

the bulb losses were 123 watts, while for 100 cycles and other conditions unchanged the bulb losses were 249 watts—an increase of 50 per cent. The reason for the rapid increase in $(W_g \div 2)$ is explained by the fact that with the rise of the frequency the transformer current

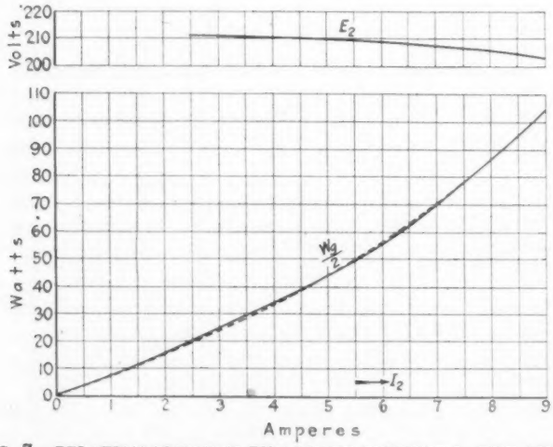


FIG. 7—RELATION BETWEEN THE ANODE CURRENT I_2, THE ANODE VOLTAGE E_2 AND THE BULB LOSSES PER ANODE $(W_g \div 2)$ FOR A CONSTANT PRIMARY VOLTAGE E_1 OF 110 VOLTS, NORMAL FREQUENCY OF 50 CYCLES AND VARIABLE LOAD

is for the same output higher than for lower frequency. The same is therefore true for the anode current and the bulb losses, which increase as in equation (10).

Hence the values of A and B are not constant, the values being as shown in the accompanying table. It is clear that the efficiency is decreased by increasing the frequency. This fact has been confirmed by F. W. Alexanderson.[4] G. Schulze[5], using my method to determine the bulb losses, found that the losses are independent of the frequency. However, in making his test, Schulze changed the frequency but kept the anode current constant. In doing this the primary voltage was

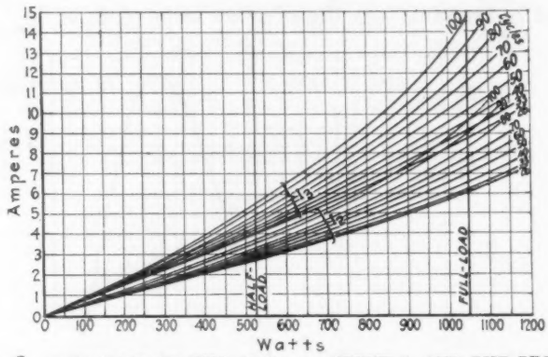


FIG. 8—VARIATION OF THE ANODE CURRENT I_2 AND THE RECTIFIED CURRENT I_2 WITH THE OUTPUT FOR CONSTANT PRIMARY VOLTAGE E_1 OF 110 VOLTS AND VARIABLE FREQUENCY

not the same for the different frequencies and the output was different.

In answering correctly the question whether or not a change in the frequency has an influence upon the bulb losses, one must determine the bulb losses for different frequencies with the same primary voltage and for the same output. Results from such a test are shown in Fig. 7 and Fig. 8, which need no further explanation. The following conclusions are to be drawn:

(l) The bulb losses depend upon the frequency, increasing with increase in the frequency.

(m) The bulb losses increase rapidly with increase in the anode current.

[4]ELECTRICAL WORLD, 1912, p. 1006; *Elektrotechnische Zeitschrift*, 1912, p. 1091.
[5]Archiv für Electrotechnik, 1913.

Replacing Telephone Cable at a Profit

It was recently demonstrated at Louisville, Ky., by the Cumberland Telephone & Telegraph Company, that a considerable profit is possible when replacing a number of small telephone cables by a few cables of large size. In this case a total of 143,129 ft. of 50-pair, 100-pair, and 200-pair underground lead-covered cable was replaced by 16,386 ft. of 400-pair and 600-pair, 22-gage underground cable. The total cost of the estimate for this work was $25,462. The estimated salvage based upon the market price of junk at the time the estimate was prepared figured $31,605. This figure was based upon the junk being sold as lead cable. An investigation in stripping the sheath from the core of the cable and burning off the paper insulation to secure the clean lead and copper, developed the fact that a net profit of approximately $12 per 1000 lb. of junk could be made, based upon the selling price of junk at $4.90 per hundredweight for lead and 20 cents per pound for copper, at the time the investigation was made. The great increase in the price of junk has greatly increased the net profit in stripping the cable. It is estimated that a profit of $7,000 to $8,000 was made upon this junk by stripping the cable instead of selling it unstripped. The estimate covering this work was completed at a cost of about 10 per cent under the estimated amount.

The greatest saving from this job was brought about by a reduction of $91,944 in the underground cable plant account and a reduction in the annual charges upon the plant dismantled of approximately $10,000.

Testing and Filtering of Transformer Oil

Methods of Taking Oil Samples—Use of Special Test Box—Preparation of Filter Papers —Improved Operation of Filter Press

BY E. P. PECK

Superintendent Tests and Repairs Georgia Railway & Power Company

A THOROUGH system of keeping track of the condition of oil in high-voltage transformers and of maintaining the oil in good condition is employed by the Georgia Railway & Power Company. When the inspection system was started, oil samples were taken from every transformer on the system each month. It has since been found that a monthly oil test is unnecessary on all transformers. It is now the practice to take samples from the in-door transformers once every three months, from the medium voltage out-door transformers once every two months and from the 110,000-volt transformers once a month.

METHOD OF PREPARING OIL SAMPLE BOTTLES

The oil samples are taken by a regular inspector who follows a system which has been very carefully worked out. Samples are taken only on dry days and before taking a sample the transformer drain valve is carefully cleaned and some oil is allowed to waste before the sample bottle is filled. The bottles used for oil samples hold 8 oz. and have large necks, which makes them easy to fill and to clean. In the laboratory these bottles are all cleaned, washed with gasoline and dried in an electric oven. The corks are also dried. The corks are fitted in each bottle and the cork and mouth of the bottle paraffined as soon as the cork is driven in. These prepared bottles are then furnished to the inspector, who again seals the bottle after taking the oil sample.

Transformers of 250 kva. or over are equipped with dry air breathers. The transformer tanks of all outdoor transformers are sealed air-tight, so that the transformer will blow back, or will raise the oil level in the gage glass when the inspector blows into the transformer through a testing pipe. The condition of the transformer, as regards tightness and the condition of the calcium chloride in the breather compartment, is noted by the inspector on each trip.

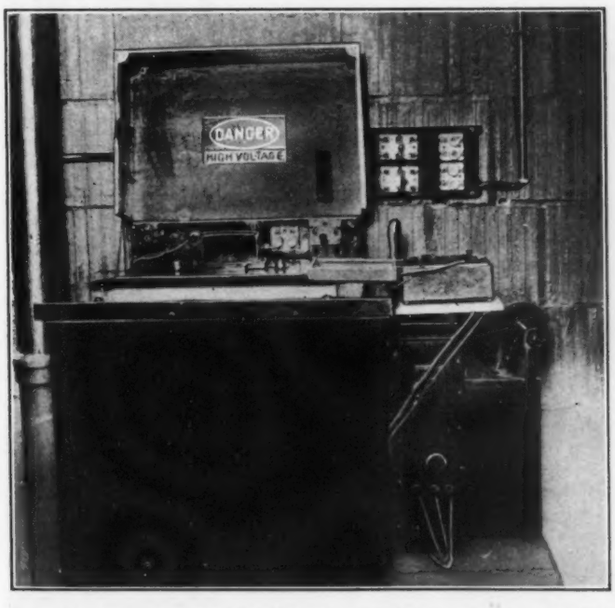


FIG. 1—OIL TEST TRANSFORMER, SHOWING COVER PROVIDED WITH SUITABLE SWITCH, FUSES AND VOLTMETER TERMINALS

All oil samples are sent to the laboratory where they are tested. Those from the 110,000-volt transformers must stand a 30,000-volt test, and samples from 22,000-volt or lower voltage transformers must stand a test of 20,000 volts to be considered satisfactory.

SPECIAL 8-OUNCE TEST BOX

The oil tests are made in a special test box which has been made in the company's laboratory. This box just holds an 8-oz. oil sample. This size of the test box has been found to possess considerable advantage over the size supplied with test transformers, which usually requires a 1 qt. sample. The oil inspectors have found that the 15 or 20 qt. bottles make a very uncomfortable package to carry, especially when the bottles were filled with oil. Also express charges on the oil samples often amount to a very appreciable annual cost. For these reasons the 8-oz. sample box was adopted. A number of oil tests were made, using this special box and the quart box to see if there was any difference in the tests when made in the different sized boxes. We could find no variation, between tests made in the two boxes, which was larger than the variation between samples of a given lot of oil tested repeatedly in either box. The spark gap used is made of two ½-in. brass rods, carefully squared and polished on the ends and edges, and set end to end, with a 0.2-in. gap between. Oil tests are conducted regularly at the laboratory, as many as fifty tests being made on some days. These tests are written up on a regular form, which is shown in Fig. 2.

Georgia Railway & Power Company

Standardizing Laboratory

OIL TEST REPORT

Oil from _____

Filtering-Inspection _____

B. D. S. I. Kilo-Volts. B. D. Kilo-Volts.

Sample No. _____ Trans. No. _____

Serial No. _____

Condition _____

Date of Sample _____

Remarks _____

B. D. S. I. Kilo-Volts. B. D. Kilo-Volts.

Sample No. _____ Trans. No. _____

Serial No. _____

Condition _____

Date of Sample _____

Remarks _____

B. D. S. I. Kilo-Volts. B. D. Kilo-Volts.

Sample No. _____ Trans. No. _____

Serial No. _____

Condition _____

Date of Sample _____

Remarks _____

Date _____ Tested by _____

_____

Head of Department.

FIG. 2—FORM FOR REPORTING TESTS OF TRANSFORMER OIL SAMPLES

Several additions have been made to the regular oil-test transformer to improve its voltage control on the lower voltage ranges and to make its use more convenient. A second water rheostat was added at the side of the transformer. A hinged cover to keep dirt off of the high voltage terminals on top is used. On the back support for this cover a main line switch, fuses, voltmeter terminals and a signal lamp have been placed, this arrangement being shown in Fig. 1.

OIL FILTERING

A great deal of study has been made of the oil filtering. We have found that much time can be saved, when the oil contains much water, by drawing a barrel of oil

off at the bottom of the transformer before the filtering is started. The oil in the transformer is then filtered to stand a 40,000-volt test. The oil in the barrel is filtered separately to stand a 40,000-volt test before being put back in the transformer.

The filter press is run for five hours continuously and then stopped for thirty minutes to allow the oil to settle. If the transformer has two outlets at the bottom, the oil in the bottom is filtered from these two outlets, for some time, using one as the intake and the other as the discharge from the press. After this oil begins to show, from the condition of the filter papers, that it is reaching a good condition, the discharge from the press is changed from one of the bottom connections to the top of the transformer, and the oil then filtered as a whole.

The oil samples should be invariably taken from the intake side of the filter press, as a sample from the discharge side will naturally stand a high test before the oil in the transformer is thoroughly dry. When taking the sample, it is well to just crack the sample valve, so that air bubbles will not be forced through the oil, as occurs when the oil is drawn too rapidly. Transformer filtering is never attempted on a rainy or even a damp day, as we have found that much time is lost when outdoor filtering is done under these conditions.

Preparation and Use of Filter Papers

When the press is set up care is taken to see that all of the pipe joints, particularly those on the intake side of the pump, are absolutely tight. All of these joints are made up with shellac. No rubber hose is used either in the filtering or in the oil sampling. When the press is in regular operation, the strainer should be cleaned every nine hours. When filtering bad oil the filter papers are changed every ten minutes for the first hour. If the oil is in fair condition, the papers are changed every thirty minutes for two hours, and once an hour after the first two hours until the filtering process is completed. At the beginning of the filtering all of the papers in the filter press are changed at each change period.

The filter papers are carefully dried in the electric oven before being used. These papers are well scattered through the oven so that each paper will be thoroughly dried. The oven is kept on a high heat for the first hour, when new papers are put in, and on a low heat after that time. Care is taken not to scorch the papers, since a scorched paper does not filter satisfactorily. The papers are taken from the baking oven and placed very quickly in the filter press without being saturated in oil.

Results With Two Filter Stacks Instead of One

When filtering was first started a regular 7-in. General Electric press was used. Later, a second filter stack was added and piped so that either of the two filter stacks could be run from one pump and motor, as shown in Fig. 3. This allows one stack to be filtered while papers are being changed in the other stack. By this means, the press is kept running continuously nine hours a day. This change has resulted in a large decrease in the cost of filtering out-of-town transformers. With the single stack press, it was the practice to send two men, so that the press could be run for two shifts of ten or twelve hours each, in order to complete the filtering in a reasonable time. With the double press one man can complete a bank of transformers in less time than was formerly required for two. All of this time saving is not due to the double press, however, part of the improvement being due to the careful attention which is paid to details, such as tight joints in the pipe lines, changing filter papers at proper intervals, etc. It has also been found that better results are obtained by letting the oil settle over night.

The regular filter man filters three 150-kva. transformers, containing about 600 gal. of oil total, in three days. This includes the time of getting the filter press from the railroad station to the transformers, uncrating and setting up the filter press, filtering the oil, crating the press after filtering and delivering it to the railroad station for shipment.

In addition to the filter man a local laborer is generally used as a helper for setting up and taking down the press which requires about six hours of his time. The time mentioned above for filtering the oil is approximately that required to raise the 200 gal. of oil from a 25,000-volt test to a 40,000-volt test. From 50 to 80 lb. of filter paper would be required for the job.

The method of handling the oil filtering and the construction of the double press were largely worked out by Mr. Benson, foreman of the company's repair shop.

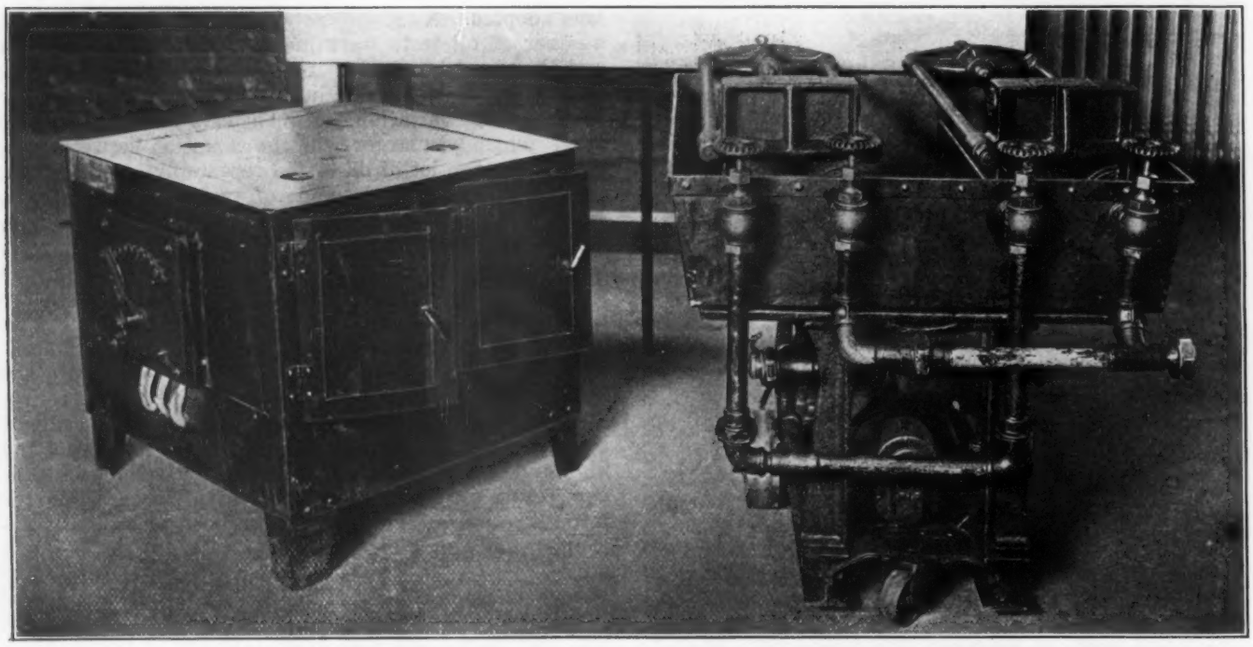


FIG. 3—SPECIAL TWO-STACK OIL FILTER PRESS AND DRYING OVEN FOR PREPARATION OF FILTER PAPERS

Electric Oscillatory Phenomena of Speaking Arc

Arrangements for Demonstrating and Experimenting with the Talking Arc and Approximate Equations for the Circuits Involved

BY J. PARKER VAN ZANDT

IN 1898 Prof. H. Th. Simon[1] of Göttingen first demonstrated that the column of incandescent vapor of an ordinary electric arc lamp could be set in mechanical vibration by variation of the current through the arc, and that the vibrating vapor path would communicate its disturbances to the air in the form of sound waves. Later[2] a modified scheme of connections was suggested whereby the effectiveness of the voice currents set up in the transmitter was much increased. The modified form is simple, direct and extraordinarily effective. Since as a lecture demonstration of electric oscillatory phenomena, it far exceeds in interest the ordinary Duddell singing arc, it is thought worth while to give a detailed description of the diagram of connections, with the required constants, and establish the approximate electrical equations for the circuits involved. The connections for the apparatus used are shown in Fig. 1.

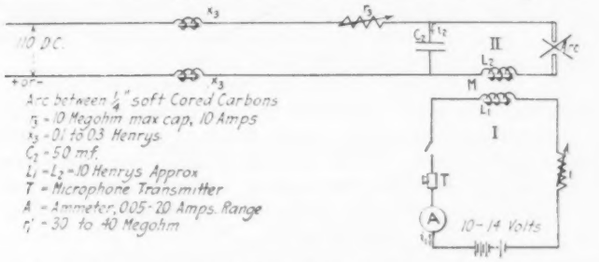

110 D.C.
Arc between 1/4" soft Cored Carbons
r3 = 10 Megohm max cap, 10 Amps
x3 = 01 to 03 Henrys
C2 = 5.0 mf.
L1 = L2 = 10 Henrys Approx
T = Microphone Transmitter
A = Ammeter, 005-20 Amps. Range
r1 = 30 to 40 Megohm
10-14 Volts

FIG. 1—TALKING ARC CIRCUIT WITH APPROXIMATE VALUES OF CONSTANTS

When words are spoken into the transmitter variable currents flow in the microphone circuit. These, superimposed upon the direct current, act inductively to produce variable currents which flow through the arc and return through the shunt condenser path. When the vapor arc sustains periodic weakening or strengthening of the current flowing through it, periodic decrease or increase of temperature results, with consequent contraction or expansion of the vapor. These changes in the volume of the vapor act upon the surrounding air and reproduce the words spoken into the microphone. The action is reversible, and if microphone and storage cells are replaced by the usual telephone receiver words spoken into the arc will be heard in the receiver.

The essential feature in the experiment is the character of the arc. To obtain the best results use a long, flaming, steady arc between 0.25-in. soft-cored carbons mounted vertically and separated approximately 3 cm. A current of 5 to 7 amp. is sufficient to insure steady burning. The condenser should have a capacity of five, or more, microfarads insulated to withstand several times the normal voltage. Any open core transformer with fairly high inductance and preferably a one to one ratio may be used. The choking coils should have moderately large values of reactance in order effectively to block the superimposed voice currents. The microphone may be of the ordinary carbon granular type, with as great an ampere capacity as possible. Too much current in the transmitter will cause "frying" of the granules, and consequent hissing in the arc. A large current flows when the arc is struck, and the arc series resistance must be selected with this in mind.

[1]Wied, *Annalen*, Vol. 64, page 233, 1898; Pierce, Principles of Wireless Telegraphy, page 254, 1910.
[2]*Physikalische Zeitschrift*, Vol. 2, page 253, 1901.

Troubles may usually be traced to the microphone circuit or to the condition of the arc carbons. An ammeter in series with the microphone should be watched constantly for possible open or short-circuits. If the arc hisses badly, cut off the burned ends of the carbons and use perfectly fresh electrodes. Avoid any breeze that tends to blow out the arc. The intensity of reproduction increases directly with the length of the flame.

It is worth while to note that the speaking arc is in no sense an improved Duddell singing arc, for the Duddell arc depends wholly upon the negative characteristic of the carbon arc and the resulting charging and discharging of the shunted condenser across the electrodes. A very short arc is absolutely essential. With the speaking arc, the long vapor path prevents the surging of the condenser, which only serves as an easy path for the variable currents. The negative characteristic of the arc is unimportant, the essential feature being the relation between the temperature and size of the vapor path and the current which flows through it.

If we consider the arc current sufficient to magnetize the transformer core to a point approaching saturation, and that the value of the superimposed voice current is only a few per cent of the arc current, we may take L_1, r_1, and L_2, r_2, C_2 as constants.

For the coupled circuits, by Kirchhoff's laws, using the symbolic notation:

$$E_1 - Z_1 I_1 - jX_m I_2 = 0 \quad (1)$$

$$Z_2 I_2 + jX_m I_1 = 0 \quad (2)$$

Hence

$$I_2 = -j\frac{X_m I_1}{Z_2} \quad (3)$$

$$I_1 = \frac{Z_2 E_1}{Z_1 Z_2 + X^2_m} \quad (4)$$

I_2 is the superimposed voice current. In order that it may be a maximum,

$$Z_1 Z_2 + X^2_m = 0 \quad (5)$$

Expanding,

$$[r_1 + j\omega L_1]\left[r_2 + j\left(\omega L_2 - \frac{1}{\omega C_2}\right)\right] = -\omega^2 M^2 \quad (6)$$

Equating the real terms,

$$r_1 r_2 - \omega^2 L_1 L_2 + \frac{L_1}{C_2} = -\omega^2 M^2 \quad (7)$$

$(r_1 r_2)$ is small in comparison with the reactance terms and may be neglected. Then

$$\omega^2 = \frac{L_1}{(L_1 L_2 - M^2) C_2} \quad (8)$$

If K = coefficient of coupling $= M/\sqrt{L_1 L_2}$

$$\omega^2 = (2\pi n)^2 = \frac{1}{(1 - K^2) L_2 C_2} \quad (9)$$

$$n = \frac{1}{2\pi\sqrt{L_2 C_2 (1 - K^2)}} \quad (10)$$

For a man's voice (n) falls between 60 and 1000 cycles per second.[3] If L_2 be chosen 0.10 henry and C_2 be chosen 5.0×10^{-6} farad, K, for the transformer with open-iron core will be close to 0.90.

Then

$$n = \frac{10^3}{6.283 \times 0.5 \times (1 - 0.90^2)}$$

$$= 520 \text{ approximately.}$$

For a closed-core transformer K is practically unity and there is no definite resonant point. The low and high tones are equally satisfactory.

[3]Helmholtz, "Sensations of Tone."

Opportunities for Young Electrical Engineers

IV—In Research and Testing

BY PRESTON S. MILLAR
General Manager Electrical Testing Laboratories, New York City

In his article Mr. Millar emphasizes the view that either for the few who will make research and testing their life work, or for others who may engage temporarily in research or testing, advantages are to be realized in the training in desirable methods, in the acquisition of the scientific viewpoint, in a broadening experience and outlook, and perhaps in useful acquaintance in particular branches of the industry.

IN the previous articles of this series and in accompanying discussions, qualifications which make for the success of the young engineer have received attention. Such qualifications are in part natural and in part acquired. Furthermore, they are found in various degrees. All of them under favorable conditions and by determined effort may be developed from a lesser to a greater degree. The young engineer confronting a choice of occupation does well to consider not alone prospects for early professional or financial advancement. His choice should be influenced also by opportunity to acquire or to develop qualifications for ultimate success.

It is this consideration which brings into relief research and testing as an occupation to be considered by the young electrical engineer. This field offers exceptional opportunities for acquiring important qualifications for success. Prominent among these is the "scientific state of mind" or the "scientific viewpoint" which the writer wishes to add to those indicated in this series.

THE SCIENTIFIC VIEWPOINT

The scientific viewpoint is of well-nigh universal applicability. Essential in research, indispensable in engineering, its value in the industrial or commercial world is fast gaining recognition. It underlies scientific management or efficiency engineering, which in one form or another is manifesting itself in all human activity.

This viewpoint once acquired is brought to bear upon all tasks and problems through a series of processes which roughly are as follows:

1. Definition of purpose.
2. Analysis of problem and listing of all variables.
3. Study of related literature and experience.
4. Adoption of approved methods.
5. Proving of method and appliances.
6. Proper conduct of research (or test or other enterprise).
7. Discussion of results.
8. Limitations of conclusions.

To apply this or a similar procedure completely or in part to all phases of industry; to investigate each subject along these lines with as much care and diligence as its importance may warrant; to ascertain the facts which it is important to know; to act logically in the light of such facts—this follows upon the adoption of the scientific point of view.

The man who can discern an opportunity or a need, who, within the limits of his knowledge and experience, is able to decide what action should be taken in the circumstances and who acts accordingly, possesses more than mere executive ability. Such a man will go far, especially if he displays the other sterling qualities which have been emphasized in this series. This combination of perspicacity, decision and action is a trait which may be developed to some extent. And an important aid to its development is the acquisition of the scientific viewpoint.

The writer of the introductory article of this series distinguished between the "business" and "laboratory" type of man, intimating that in the future these two types are likely to merge successfully. This may be considered in connection with the unrelated facts of vocational fortuity and increasing specialization. If our industry suffers from misfits and if training tends toward narrow specialization, it is important to inculcate the fundamental principles which are the prerequisites of success. Application of such principles tends to reduce in extent the misfitting and to mitigate the evils of excessive specialization. It likewise promotes the merging of the "laboratory" and "business" type. Among these principles the scientific method must be conceded an important place.

But the scientific viewpoint contributes not alone to material success. We find things uninteresting only when we know too little about them to appreciate their potential interest. When viewed in the scientific spirit, everything becomes interesting. The scientific viewpoint develops interest, promotes investigation and inspires to further achievement.

THE ADVANTAGES OF LABORATORY WORK

The engineering course affords the undergraduate opportunity to acquire the scientific state of mind, as does also engineering practice. But work in a research or testing laboratory is especially favorable to its acquisition. Knowledge gleaned from personal experience is more useful and significant than that acquired from others. Scientific methods become habitual only through practice. A laboratory is a fact factory. To seek facts, either with or without reference to their application, is to foster the scientific spirit, which through practice becomes thoroughly ingrained and constitutes an important qualification for success.

Work in a laboratory develops manual dexterity, trains observation, teaches necessity for predicating conclusions upon facts only.

Research and testing often afford an opportunity to gain a diversified knowledge of materials and apparatus. This knowledge, if limited to laboratory performance, may be inadequate in that the practical service experience is lacking. On the other hand, so far as it goes, it is soundly based upon facts. It is the best possible foundation upon which to erect an operating experience. Also it is an excellent safeguard against the temptation which so often assails practical engineers to draw conclusions from impressions founded upon inadequate data compounded of effects of variables which have not been segregated.

Laboratory work may bring the young engineer into contact with several phases of the industry, including manufacturing, selling and both the engineering and commercial branches of electrical operation in the several fields. While such contact usually is casual, yet it frequently takes place in those phases of the work which offer the most interesting engineering opportunities.

Work of this kind occasionally affords the young engineer means of becoming known favorably in one or more branches of the industry. The experience gained should be developmental, widening the outlook.

If the laboratory is engaged in industrial research or in commercial testing, the work may afford the young engineer an opportunity to acquire knowledge of the viewpoints and methods of both manufacturer and consumer, seller and buyer. This lends business perspective.

CONDITIONS IN THE LABORATORY FIELD

The opportunities for employment in electrical research and testing are relatively few. The government laboratories, notably the Bureau of Standards, are one class of employers in this field. There are a few small private laboratories. Large manufacturing corporations in increasing numbers are maintaining research laboratories. Large operating corporations in increasing numbers are maintaining testing laboratories. While this field is being extended and expanded, yet it can offer employment yearly to only a very limited number of young men. The largest electrical manufacturers yearly employ considerable numbers of graduates in an apprentice course. The scope of their engineering departments comprehends a certain amount of investigation work. Both offer excellent opportunity for acquiring useful experience and some opportunity for acquiring the scientific viewpoint.

The successful research man must possess somewhat unusual qualities with which few are endowed. But a small proportion of engineering graduates will look forward to making research or testing a life work. For these few, employment in a laboratory is of course immediately desirable. The great majority, by force of circumstances, inclination or training, will be directed into other branches of the industry. Many ultimately will find their way into designing, manufacturing, operating, commercial or consulting work.

Remuneration in research and testing for the young engineer probably averages about as in the manufacturing and operating branches of the industry. Later compensation, of course, depends upon merit and opportunity as in other forms of business. A small branch of the electrical industry, testing, offers fewer important and highly remunerative positions. On the other hand, there are few men eligible for such positions. Upon the whole there is probably little ground to select or to avoid research and testing for reasons of compensation only.

To Differentiate the Training of the True Engineer from That of the Technically Trained Worker

To the Editors of ELECTRICAL WORLD:

In the series of articles on "Opportunities for Young Engineers," now appearing in your paper, I believe you are doing a distinct service to young men who are about to graduate from technical courses. It too frequently happens that a young man has little or no information to guide him in choosing the branch of the industry which he wishes to enter. Frequently, the prospect of a high salary may be the deciding factor.

To the writer, the chief value of the articles lies in the information which they give regarding the kinds of positions for which men are needed, and the qualifications required of the men who are to fill these positions. It would seem obvious that an institution which prepares a certain kind of educational product should learn from the consumers of that product their needs, both as to technical training and the other characteristics which the graduates should possess. The needs of the industry should determine the kind of instruction given. When we consider these needs we find them divided into three kinds:—(*a*) The artisan, (*b*) the technically trained worker, (*c*) the engineer in the restricted sense. In the first class would be included skilled labor which works with its hands, and for which the training of the trade school is sufficient. In the third class are included real research and designing engineers and executives of great ability. For this class, the training of the four-year engineering course is not sufficient.

Between these two groups lies the second group, which is somewhat vaguely defined as to its boundaries, merging as it does into group *c* on one hand and into group *a* on the other. In group *b*, however, two-thirds or more of all the technically trained graduates find their place. In this class would be salesmen, routine engineers, superintendents, managers, foremen, and operating engineers. In other words, I would restrict to the third class the relatively small number of men who carry out the most important engineering or research work, or occupy executive positions of very great responsibility.

I do not intend to belittle the positions in the second group, but only to restrict to the third group men of the—say—Steinmetz or Whitney types. It is the writer's opinion that there is a tendency at present to give engineering training which is better suited for men who would find places in the third group, forgetting that the number which can profitably receive such training is relatively small.

Without examining in detail the requirements of the larger number which must fall in group *b*, I think it is apparent that a good knowledge of business practice and of modern productive methods is essential. I believe the present training could be broadened without sacrificing the necessary *fundamental* technical training. It might be necessary to omit some of the specialized courses in the practice of one branch or another of the industry, but I believe this would be a good thing. The school is the place to get the fundamentals, and the detailed practice in any particular branch of the work can be obtained better after graduation, or sometimes, in part at least, by summer work with industrial concerns. The series is welcome, therefore, for the information which it is giving regarding the requirements in the industry.

A consideration of the facts set forth in these articles, together with interviews which the writer has had with many employers, indicates that besides a thorough training in the fundamentals of the science, the graduates should possess other qualities which are of equal or greater importance. Among these may be mentioned initiative, executive ability, tact, common sense, accuracy and reliability. The possession of these characteristics in a greater or less degree determines the success of a man more than technical training. While many of these characteristics are inherent in a man, they may be developed to some extent by proper training. The institution with which I am connected has for the past two years graded its graduating classes, in addition to their technical studies, upon characteristics such as those given above. I have found this grading very useful when recommending men to fill positions, and I therefore welcome further information regarding the qualities which employers desire that their men should possess.

A. L. COOK,
Head of Department of Applied Electricity, Pratt Institute.
Brooklyn, N. Y.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Operating Expenses for Massachusetts Steam Stations

The data in the accompanying table represent an analysis of the operating expenses of steam-electric stations in the State of Massachusetts as reported to the Board of Gas and Electric Light Commissioners and contained in its recent 1915 report. The figures for 1914 are summarized from an extensive table published in the Aug. 7, 1915, issue of the ELECTRICAL WORLD, page 303, which gives data for each of nineteen companies as compiled from the report made last year by the commission. The figures given in the second column are for the twelve months immediately following the period covered by the previous report and compare very closely in practically all items. While varying conditions due to size of station, output, plant factor and load factor are ignored in average data of this kind, they indicate in a general way the trend of operating costs for the particular items shown. For instance, it is interesting to note that the amount paid for taxes per kilowatt-hour by the important Massachusetts stations is considerably more than half the cost of coal per kilowatt-hour, also that the amount charged to office management and taxes combined is about 85 per cent of the total cost of station operation. The averages for the stations in 1915 show the cost of fuel to be 62.0 per cent of the total station operating expense, and wages 23.8 per cent, the remaining 14.2 per cent being accounted for by such items as oil, waste, water, tools and repairs. Of the seventeen stations for which data are given in column two of the table, ten are in cities of from 30,000 to 100,000 people, three below this range and four above. The yearly station output varies for the most part between 5,000,000 and 15,000,000 kw.-hr.

OPERATING EXPENSES FOR MASSACHUSETTS STEAM STATIONS HAVING AN ANNUAL OUTPUT OF MORE THAN 5,000,000 KW.-HR.

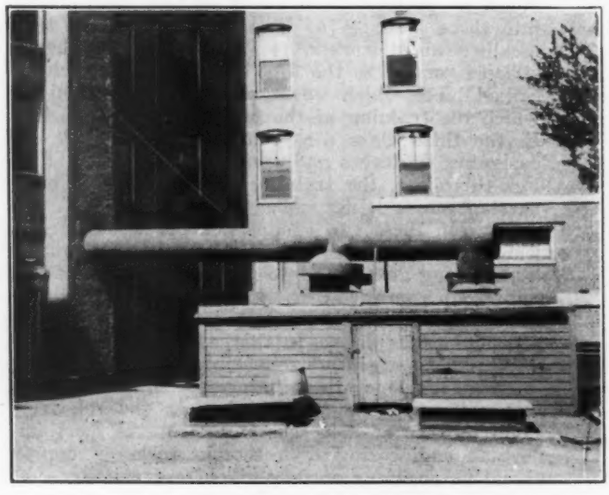
	Average for Nineteen Stations in 1914	Average for Seventeen Stations in 1915	Data for Boston Edison Company	
			1914	1915
Cost of coal, dollars per ton	4.09	4.24	3.92	3.90
Coal per kilowatt-hour in pounds	3.05	3.15	2.12	2.06
Operating expenses due to station operation, in cents per kilowatt-hour made:				
Coal	0.570	0.560	0.373	0.359
Oil and waste	0.008	0.007	0.002	0.002
Water	0.022	0.023	0.011	0.010
Wages	0.216	0.215	0.150	0.161
Station repairs	0.018	0.018	0.006	0.009
Steam equipment repairs	0.051	0.055	0.032	0.051
Electric equipment repairs	0.015	0.015	0.064	0.060
Tools and appliances	0.008	0.010	0.018	0.017
Total for station operation	0.908	0.903	0.656	0.669
Operating expenses due to distribution, in cents per kilowatt-hour sold:				
Lines and conduits	0.170	0.180	0.315	0.305
Meters and transformers	0.055	0.031	0.120	0.052
Tools and appliances	....	0.060	....	....
Wages	0.198	0.175	0.025	0.078
Total for distribution expense	0.423	0.446	0.460	0.435
Expenses of office management	0.344	0.387	0.701	0.701
Taxes	0.314	0.378	0.602	0.590
Miscellaneous	0.147	0.097	0.197	0.137
Net operating income	1.492	1.615	2.314	2.181

Data for the system of the Boston Edison company is not included in the averages of the table, mainly for the reason that the company's 1915 output of 198,389,589 kw.-hr. is more than 90 per cent of the combined outputs of the seventeen stations reported. The operating and cost data for the Boston company also represent results of a highly specialized system operating stations and equipment which favor reduced costs per kilowatt-hour. It is therefore interesting to compare separately the items of cost for this extensive system with the averages for other stations of the State having an output that permits comparisons of station performances. The station operating cost for the Boston company is reported as 0.669 cent per kilowatt-hour, of which the fuel cost is 53.6 per cent and wages 24 per cent. Here it is to be noticed that although the output of the system is nearly equal to the combined outputs for the seventeen other stations, the amount charged to wages is the same as for the other and much smaller systems. The fuel cost per kilowatt-hour is again nearly 40 per cent less than that for the average of the other stations of the State. This is probably due in the main to a better load factor, plant factor and economy of large units and modern methods of burning and handling coal. The figures for the Boston company also show that the amount charged against taxes is about 90 per cent of the total cost of station operation, while the amount spent for taxes and office management is nearly twice that called for by station operation.

The total of the table showing distribution expense for the Boston company is not the same as the total given in the report of the commission for the reason that only the main items of expense have been considered. The expense of distribution given by the commission is 0.665 cent per kilowatt-hour. The total for expenses of station operation, however, is only lower by a charge of 0.018 cent per kilowatt-hour entered as an expense of manufacture under the heading of rentals.

How the Smokestack of a Hotel Plant Was Made Inconspicuous

In the boiler plant of a Maine hotel it was found to be undesirable to carry the stack straight up from the fire room on account of interference with the natural lighting and the shadow annoyance in a courtyard bor-



CONNECTION OF BOILER UPTAKE WITH STACK IN HOTEL COURTYARD TO PREVENT SHADOW ANNOYANCE

dered by many rooms. The stack was accordingly built of brick and designed with a rectangular cross-section permitting it to be carried upward close to the building wall.

Connection with the boiler uptakes is effected by an iron smoke pipe run almost horizontally from the top of the boiler house monitor to the stack. This smoke pipe is 3 ft. in diameter and supported by a strap-iron cradle and adjustable brace rod. By this arrangement of stack and smoke pipe the draft has suffered but little and the view in the hotel courtyard is practically unobstructed.

Operating Costs for Several Diesel Engine Installations

In what follows operating data are given for several plants operating Diesel engines under different conditions and for different types of service. At Rice Lake, Wis., the Red Cedar Valley Electric Company has installed a 225-hp. Diesel unit to operate in parallel with two 150-kw. water-wheel units over peak periods as an auxiliary. This unit is operated by the station attendant who looks after the water-wheel generators, therefore no extra labor charge is called for. At present the Diesel unit is operated during the heavy day load, from about 8 a. m. to 10 p. m., and the water wheels used to carry the lighter load are operated during the remainder of the twenty-four-hour period. The ability to install the Diesel unit in the existing hydroelectric station and operate it by the regular force was an important consideration in its selection. Fuel oil costs at this point 3.3 cents per gallon and lubricating oil 39 cents per gallon. Under an average load of 76 kw. the fuel cost for this installation, as reported by Louis Dunneboil, manager of the company, is 0.39 cent per kilowatt-hour and the lubricating oil cost 0.05 cent per kilowatt-hour.

The City of Lyndon, Kan., operates a 120-hp. Diesel unit, and R. W. Wright, superintendent, reports a generating cost of 1.66 cents per kilowatt-hour including labor, fuel, lubricating oil and waste expenses. The output of this station for 1915 operating 5614 hours was 162,307 kw.-hr. For long light load periods only 29 per cent of the unit's rating was used.

In Fig. 2 the results of a test on the 350-hp. unit illustrated in Fig. 1 are shown. This unit is installed in the plant of the City of Madison, S. D., and the curves of Fig. 2 were the result of an acceptance test on the equipment made by Charles B. Trimmer, consulting engineer of Madison. It may be pointed out that the fuel economy was practically constant at loads above 175 kw. Below this, however, the unit fuel consumption increased more rapidly with decrease in load. The cost of fuel per hour when carrying a 100-kw. load was only 4.3 cents more than with a 75-kw. load.

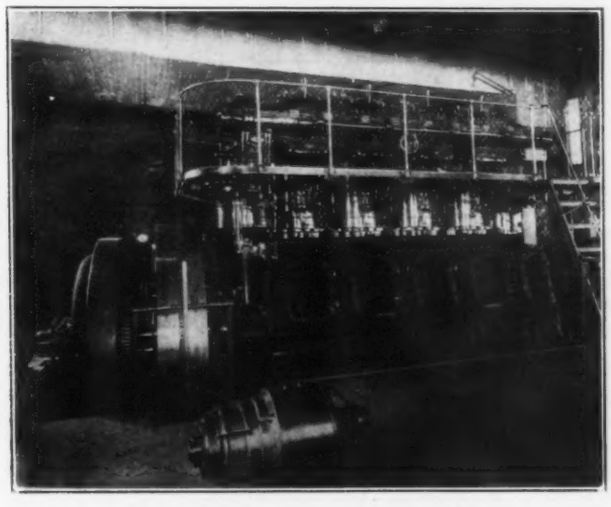


FIG. 1—A 350-HP. DIESEL ENGINE INSTALLATION OPERATED BY CITY OF MADISON, S. D.

According to a performance report on three Diesel units operated by the Anheuser-Busch Brewing Association of St. Louis, 1,006,448 kw.-hr. were generated during 1915 on 99,385 gal. of fuel oil, showing an average of 9.86 gal. per 100 kw.-hr. and a fuel cost of 0.232 cent per kilowatt-hour. The lubricating oil used was 1026 gal., costing 35 cents per gallon and 0.037 cent per kilowatt-hour. This installation has an engine rating of 900 hp. and a generator rating of 640 kw., and operates ten hours a day with a load factor of 77 per cent. The labor cost at this plant is around 0.27 cent per kilowatt-hour and average maintenance and repairs 0.0212 cent per kilowatt-hour. The Diesel units in the installations mentioned are of the design built by the Busch-Sulzer Brothers-Diesel Engine Company, St. Louis, Mo.

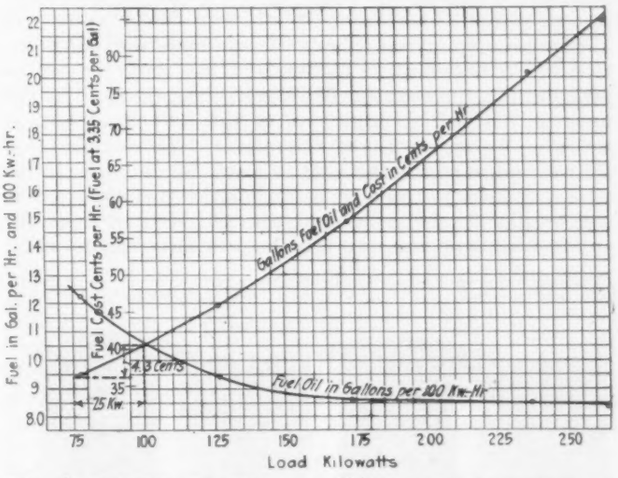

Fuel in Gal. per Hr. and 100 Kw.-hr.
Fuel Cost Cents per Hr. (Fuel at 3.35 Cents per Gal)
Gallons Fuel Oil and Cost in Cents per Hr.
4.3 Cents
25 Kw.
Fuel Oil in Gallons per 100 Kw-Hr.
Load Kilowatts

FIG. 2—RESULTS OF TEST ON 350-HP. DIESEL ENGINE AT MADISON, S. D.

Arrangements to Operate an Exhaust Fan for Emergency Service

R. L. HERVEY

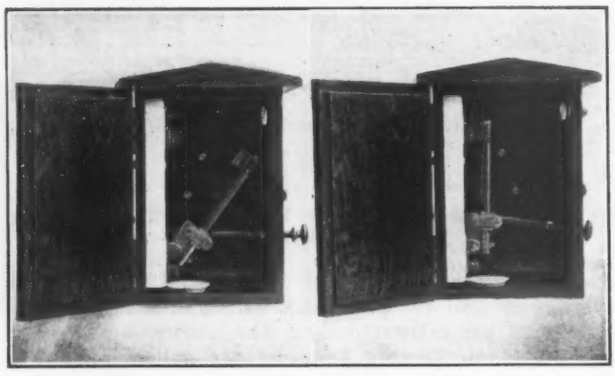
An exhaust fan which removes the hot air out of the boiler and engine room of a department store plant was shut down one recent hot day on account of injury to the armature of its driving motor. As the plant was located in the basement of the store, the heat could not be prevented from going into the other departments. The fan was built in the wall and could not be replaced in a hurry by anything but a duplicate and there was not one in the town. To relieve conditions, the armature and field coils of the motor were taken out, and a shaft was turned to fit the blade and armature bearings, with an extension on the commutator end for a pulley. An extra motor was set on the floor and belted to the fan shaft. Although the extra motor was larger than the original one, the same starting box was used as the load on both motors was the same.

When the repaired armature was replaced an ammeter was put in the line in order to make sure that the motor was not overloaded. The ammeter showed an overload of 10 per cent with the old setting of the brushes. Under ordinary conditions this load could have been carried satisfactorily, but as the motor was

directly in a draft of hot air, the insulation had been destroyed. By shifting the brushes forward just a little, the current was dropped to a lower value than the rated amperage of the motor. Too much care cannot be exercised when setting the brushes on a vacuum or blower motor, as the power required varies as the cube of the speed.

A Disconnecting Switch and Fuse Box for 6600-Volt Distribution Lines

The accompanying illustrations show the construction of a disconnecting switch and fuse box for use on distribution lines up to 6600 volts and from 1 to 100 amp. as devised by engineers of the Columbus (Ohio) Railway, Power & Light Company. The switch is of simple design and is inclosed in a wooden box which has an arc discharge hole of porcelain in the bottom. A wood pull-rod on the side operates this switch from the outside without opening the door. This construction



CONSTRUCTION OF DISCONNECTING SWITCH AND FUSE BOX SHOWING FUSE OPEN AND CLOSED

makes unnecessary the use of rubber gloves or tongs when the switch is operated. The leverage which the handle makes with the switch arm is short and gives quick make and break contact, thus eliminating arcing. The construction is such that no springs are used. Melting and welding across terminals is prevented by widely separated poles.

The features of this switch are its safety in operation and the fact that it will instantly clear the circuit or the device which it controls from the main circuit. When it is necessary to insert a new fuse, the lineman completes the operation and closes the door before he closes the switch, thus obviating the risk of an immediate fuse blow-out in his face.

Insurance against delay due to fuses being blown is secured by the fact that the trouble man can see from the ground whether the paper indicator which blows out of the arc-discharge hole when the fuse blows is ruptured. This feature is especially valuable in electric storms and other general disturbances on the line which may cause several transformers to go out of circuit at the same time. Also, on three-phase installations where one fuse is broken mechanically or otherwise, inspection may be made without interfering with customers' installation.

The operation of the switches on the system of the Columbus Company have been satisfactory. Twenty-five of them have been in operation for a year where other types of high-tension fused switches and cut-outs have been heretofore used. This disconnecting switch and fuse box has been devised by B. L. Chase, superintendent of lines, and Harry Fisher, foreman of the Columbus Railway, Power & Light Company, and has been patented by them.

Causes of Telephone "Noise" and Its Elimination

Explanation of the Effect of Atmospheric Conditions, Induction and Static Influence on Telephone Systems Operated by Transmission Companies—How These Disturbances May Be Offset

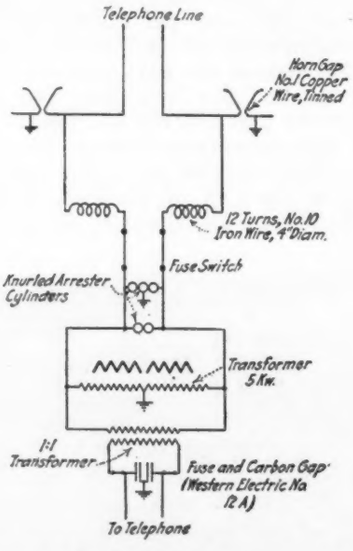
By Frank T. Coldwell

Superintendent Mohawk Hydro-Electric Company, Ephratah, N. Y.

The causes of "noise" on telephone circuits paralleling transmission lines are not generally clearly understood. The following may serve as a brief explanation of this phenomena and of the function of some apparatus used in connection with telephone lines to minimize disturbances.

A telephone receiver may be considered as an extremely sensitive indicator of change in potential. For instance, if a telephone is connected to two wires of the same potential no noise will be heard, no matter how high that potential may be, but a very slight difference in the potential of the two wires will cause a current through the receiver and the line is said to be "noisy." Unequal potential in the two wires of a telephone circuit may be caused by "weather," "induction" and "static."

Two wires extending across country on insulated supports will have a certain static potential to ground. This "atmospheric charge" will depend upon the weather, the height of the wires above ground and the degree of insulation. By using insulators of good and uniform quality and frequently transposing the wires so that their average clearance above ground is the same, the potential of the two wires will be maintained equal, and consequently the line will be "quiet" as long as no other factor enters to disturb the equilibrium. However, in a rain and wind storm, when moisture is alternately deposited on and blown off the insulators, the charge on the wires varies. Again, if a wet branch is blown against one of the wires, the wire will be dis-



ARRANGEMENT OF GAPS, DRAINAGE COIL AND TRANSFORMER TO PROTECT TELEPHONE AND USERS

charged. When the branch moves out of contact the charge will build up again. In either case the relative variation in the potential of the two wires will cause a current through the receiver and produce a noise which sounds very much like the noise caused by wind or tree branches "scratching" the conductors.

When a telephone line is near a circuit transmitting current for power or lighting, the equivalent of a trans-

former exists. The power circuit is the primary and the telephone circuit is the secondary. The potential induced in the secondary (telephone line) may cause a current through the telephone receiver and noise will result. Now, if the secondary of a transformer is divided into two sections and they are connected in opposition, no current will flow in the secondary when an emf. is applied to the primary. Just so with a telephone line. If it is divided into an equal number of sections, and transposed so that the induced potential in one half opposes and exactly equals that in the other half, the result is zero.

In all constant-potential systems the transmission wires have a certain potential to ground. In the case of a three-phase system having a grounded neutral, this potential is maintained dynamically and is equal to the voltage between wires divided by the square root of three. If the neutral is not grounded, the potential to ground is the same, but in this case it is a static potential. In either case, if a telephone line is placed near the transmission line, the telephone wires will receive an induced static potential to ground. If the telephone wires and the devices connected thereto are sufficiently insulated, and the telephone wires are either symmetrically arranged with respect to the power wires or properly transposed, the potential of each wire, due to static induction, will be the same. Undisturbed conversation may be held over the telephone line, although its actual potential to ground may be several thousand volts.

If the two sides of a telephone line are connected to ground through resistors, "static" charges will be drained from the wires and their potential will become lower, depending upon the value of the resistance. If a low enough resistance is used to properly drain the line, the resistors (being in series across the line) will shunt the telephone instruments and make talking and ringing impossible. However, if an impedance, such as the primary of a 2200-volt transformer, is connected across the line and the middle of the coil is grounded, the inductive effect through one half to ground will be balanced by that in the other half. Consequently, the line will be drained just as though so much wire were arranged non-inductively. Since shunted ringing and talking currents must pass from end to end of the winding, its full impedance is offered to those currents and there will be very little interference in talking and ringing.

With very high-voltage lines, drainage coils may permit the use of cheaper telephone insulators and less clearance between the power wires and the telephone wires. In any case drainage coils will greatly add to the convenience and safety to linemen who have to work on the line. Since the lower the static potential the less chance there is of leaks and consequent unbalancing, drainage coils may be of decided benefit. Of course, if a line is not properly arranged with respect to the conductors, and properly transposed, the addition of drainage coils will not correct that condition.

It appears to be quite generally believed that telephone transformers, will in some mysterious way eliminate noise due to weather, induction or static, whereas the primary functions of telephone transformers are (*a*) to permit the use of ordinary wiring and instruments, (*b*) to protect the operator from shocks due to the static charges, and (*c*) to protect the inside wiring, instrument and the operator in the event of a cross between the power conductors and the telephone line. In cases where noise is reduced by the installation of telephone transformers it may be found that the noise was due to "leaks" in the inside wiring or instruments.

Some telephone transformers are supplied with a middle tap in the primary winding. If this lead is connected to the ground, the device will perform the function of a drainage coil as well as that of an insulating transformer. In many cases, however, the resistance of the winding is too great to satisfactorily drain the line and for that purpose a separate device of greater capacity is used.

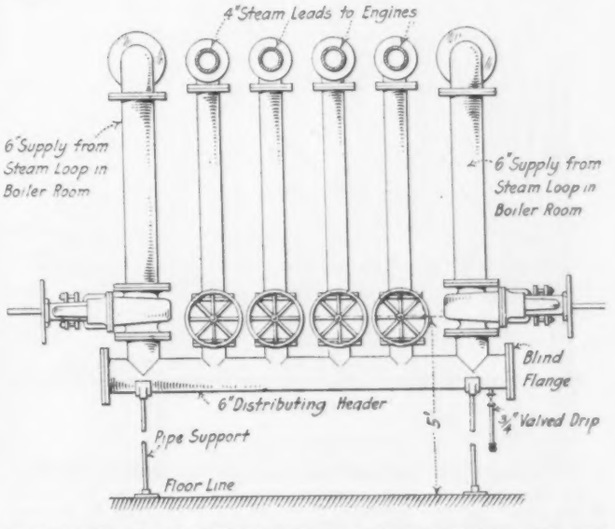
If ordinary telephone arresters are installed on a telephone line having a high static potential to ground, there may be an intermittent or even a continuous discharge across the gaps to ground. The balance in the potential of the two telephone wires will be very unstable and the line will be extremely noisy. If the gaps are made great enough to prevent the discharge of "static," the line may become quiet but the arresters will not protect the instruments from discharges due to lighting as effectively as with a narrower setting. This is due to the fact that it is practically impossible to set two gaps so that they will discharge simultaneously. When one leg of the arrester discharges before the other, that leg is then at practically ground potential and momentarily the telephone instrument with which it is connected is subjected to the full potential of the other wire to ground. This potential may be the static potential received from the transmission wires plus a further static potential due to the lightning.

The conditions mentioned herein may be corrected by arranging the protector with (*a*) gaps to ground great enough to prevent the discharge of static under normal conditions, and (*b*) a small gap between the two legs of the telephone circuit. If one of the gaps (*a*) breaks down before the other, the unbalanced potential may discharge across the small gap (*b*) rather than through the transformer and (inductively) through the telephone instrument.

Grouping Control Valves for Accessibility

BY T. W. REYNOLDS

In the accompanying illustration an arrangement is shown whereby the important steam control valves on lines to engines are grouped at one point accessible from the floor. A 6-in. distributing header with valved drip line is located in the engine room and connected by 6-in. lines, one at each end to the steam loop in the boiler room. These two latter lines are provided with valves near the floor turned sidewise to lie along the wall while the 4-in. leads to each engine are similarly valved with wheels extended out toward the front, the whole making a convenient and neat-appearing arrangement.



A CONVENIENT ARRANGEMENT OF CONTROL VALVES ON DISTRIBUTING STEAM HEADER

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

Graphic Aid in Figuring Power Bills

Form of Chart with Which the Motor-Service Salesman Can Quickly Estimate the Cost of Operating a Given Machine

BY R. W. PARKER

The power salesman of to-day is being continually confronted with the questions put by prospective customers: "How much will it cost to operate this motor after it is installed?" or "What will be my monthly bill for service if I install electric drive?"

In order to make a fair estimate in answer to these natural inquiries the following information is needed: (1) The horsepower required to drive the machine or machines. (2) Standard sizes of motors available. (3) Efficiencies of various motors at different loads. (4) The hours per month during which the motor will be in operation. (5) The rates at which energy is sold for power purposes.

Of the above data, Nos. 2 and 5 are already accurately known, while Nos. 1 and 4 can be closely estimated from manufacturers' data and from the known conditions of operation. But even with this knowledge, motor efficiency curves must be available, and considerable figuring must be done before an accurate estimate can be given. The accompanying curves were, therefore, plotted and combined in such a manner as to eliminate all figuring, and still take into account all of the factors entering into the calculation of a prospective customers' monthly bill.

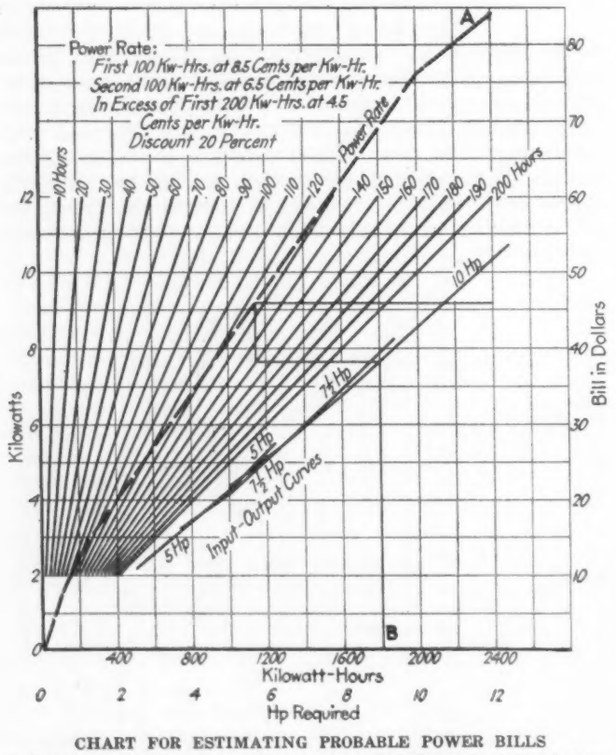


CHART FOR ESTIMATING PROBABLE POWER BILLS

Starting with the horsepower required, indicated at the bottom of the chart (in the example, 9 hp. at *B*) project up to intersection with motor-efficiency (input-out) curve, giving kilowatts input (see left margin). Crossing to diagonal corresponding to hours' use per month, and again projecting up to intersect rate curve, read at right resulting monthly bill, $46.20.

The set of curves at the right in the diagram—those marked 5 hp., 7.5 hp., and 10 hp.—are input-output curves plotted for the different sizes of motors from data obtained from a well-known motor manufacturing company. The larger fan-shaped group of curves—labeled ten hours, twenty hours, etc.—show the number of kilowatt-hours consumed for various numbers of hours' use per month. The heavy broken line, *OA*, represents the rate at which motor service is sold by the operating company.

It will be readily seen from the method of plotting, that, starting at the bottom of the sketch with the motor horsepower, and using the input-output curve, the kilowatt demand can be read directly at the left. From the demand in kilowatts, using the curves of hours' use, the kilowatt-hour consumption can be read from the bottom scale, and from this kilowatt-hour consumption, using the rate curve, the cost of power can be obtained.

As an example of the method of using the diagram, assume the following case. A machine requiring 9 hp. is to be run six hours a day and twenty-five days a month. What will be the monthly bill for service at the rate stated in the diagram?

Start on the horizontal axis at the point marked *B*, which corresponds to 9 hp. as read on the lower scale; proceed vertically to the curve marked 10 hp. (since a 10-hp. motor would be used in this case). From this point proceed to the left to the inclined line marked 150 hours (this number representing the total hours per month during which the motor will operate, as stated in the problem), then vertically to the rate curve, and read $46.20 from the scale at the right. This figure then represents the total dollars per month cost, of electric service under the assumed conditions.

To check this result by direct calculation

$9 \times 746 = 6714$ watts demand at 100 per cent efficiency.

Efficiency of 10-hp. motor at 90 per cent load—about 87.5 per cent.

$$\text{Actual demand} = \frac{6714}{0.875 \times 1000} = 7.67 \text{ kw.}$$

Energy consumption $= 7.67 \times 150 = 1150$ kw.-hr.

From the rate schedule:

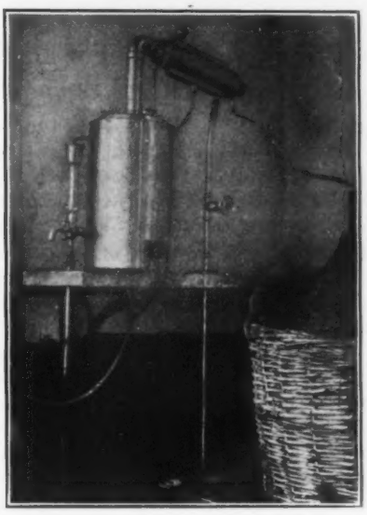
100 kw.-hr. at 8½ cents	$8.50
100 kw.-hr. at 6½ cents	6.50
950 kw.-hr. at 4½ cents	42.75
Total (gross) amount	$57.75
Discount	11.55
Net amount	$46.20

The curves herein shown may be plotted to any convenient scale, and of such size as to fit the salesman's notebook. If the scale is large enough all sizes of motors from 1 hp. to 20 hp. may be shown on one sheet, but to avoid confusion it seems best to show only two or three sizes on a sheet, thus using three or four sheets for a complete set.

These curves also afford an easy and accurate method of determining which motor is best suited to carry a given load. The choice of a size larger or a size smaller motor will often make an appreciable difference in the monthly bill, which would not be apparent from simply noting the conditions of operation.

Electrically Heated Still Used by Central-Station Garage

At the garage of the Greenfield (Mass.) Electric Light Company a convenient electrical still is used. The apparatus is shown in the accompanying illustration and consists of a vessel in which water is boiled by supplying energy at 110 volts to five 400-watt heating units. A pipe leads to a condenser through which cold



ELECTRICALLY HEATED STILL THAT DELIVERS 1 GAL. OF DISTILLED WATER PER HOUR

water flows in a helical coil, and the condensed steam is carried by a tube to the carboy shown at the right. About 1 gal. of distilled water can be produced per hour. The equipment is located in a corner of an oil room, and is compact and serviceable.

Developing Unwired Communities with the Help of Journeymen Contractors

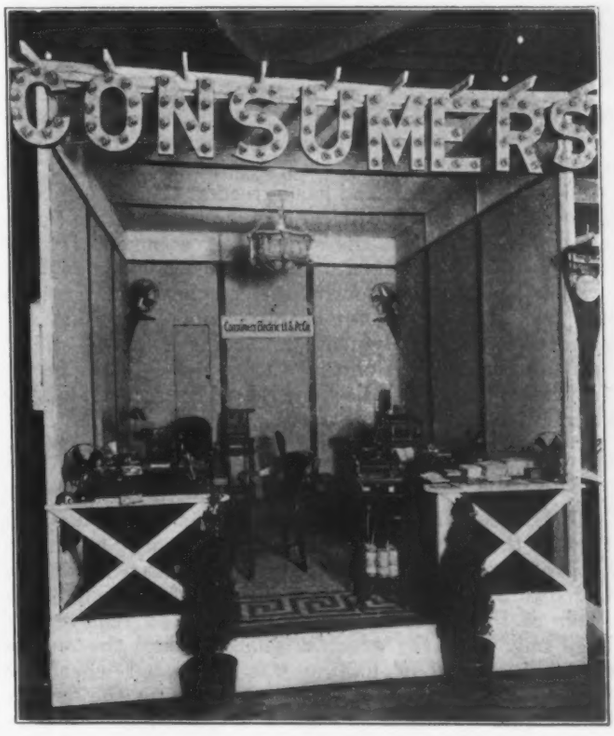
The Ohio Service Company operates an interconnected transmission system in portions of Coshocton, Guernsey, Tuscarawas and Harrison Counties, Ohio, serving some nineteen communities. An account of the engineering features of this system was published in these columns on June 3.

Since many of the communities are too small to support an electrical contractor, the electric service company, in developing new business, usually engages contractors from the larger towns and has them "camp out" in the territories under development until they have thoroughly canvassed the towns for house wiring. In this campaign the electric service company co-operates, having one or several solicitors work jointly with the contractors as conditions demand.

To make this method of securing new business effective only contractors are engaged who will wire houses at a low unit price which has been agreed upon by progressive contractors in the company's territory. About $1.78 per outlet or $2.90 including globes, bulbs and drops have been the average wiring charges, although $1.50 an outlet is the unit price which has been recently agreed upon. At present, the line foremen or meter setters inspect work done by the contractors to insure reasonable safety since very few of the towns have electrical inspectors, although they have been shown the advisability of jointly hiring one. To minimize the possibility of the contractors employing low-grade construction the electric service company embodies wiring rules in its agreements with them which form the basis for inspection, and in addition inquires as to the satisfactoriness of the contractors' work and prices from the customers. In this manner, contractors who do not live up to their agreements with the central station company become quickly known and are replaced by others who will. For a time the electric-service company carried the accounts, paying the contractor on completion of work and collecting from the customer on the prolonged payment plan. It may do so again, although the contractors are collecting directly from the customer now. The company also instructs the contractors how to sell appliances and maintains demonstrations at different periods of the year but especially before Christmas. Appliance salesmen are equipped with cent-per-hour meters so they can demonstrate to customers exactly how much it will cost to operate different devices. These instruments are also provided at each branch office for the same purpose.

The Electrically Equipped Office Exhibit and Its Message to the Housewife

During the recent Jovian Electric Show at New Orleans, La., the Consumers Electric Light & Power Company of that city was one of the twenty local exhibitors of electrical appliances and had its booth fitted up as an electrically-equipped office containing a motor-driven multigraph, an addressograph, a dictating machine and an adding machine, together with several electric fans. A dictaphone operator was constantly in attendance. In addition to interesting business men, the idea of the exhibit, according to W. J. Aicklen, Jr., general manager of the company, was also to convey to the minds of housewives visiting the show the thought that if it is economical to operate an office by electricity, the operation of the home by electric power will be equally economical and conducive to greater comfort and convenience.



ELECTRICALLY DRIVEN OFFICE MACHINES IN EXHIBIT OF THE CONSUMERS POWER COMPANY AT THE NEW ORLEANS JOVIAN SHOW

A LONG-HOUR SIGNBOARD LIGHTING LOAD

An Electric-Lighted Store Directory Sign

The electric-lighted signboard directory illustrated herewith is installed in a prominent location at Paterson, N. J., and, as shown, is divided up into a number of panels each measuring 3 ft. by 5 ft. in size. These individual spaces are rented to local merchants and to other advertisers, whose printed cards are protected from the weather by panes of glass held in place by screws. With this glass protection the signs remain clean and bright. The displays are lighted by rows of 40-watt tungsten lamps in metal angle-reflectors mounted above the signboard. In the case of this Paterson sign the spaces were readily rented and the display has been a profitable investment for the owner, in addition to furnishing a long-hour load for the central station company. It has been suggested that boards of this type would prove useful at railroad and trolley terminals in many towns and cities, since such a board constitutes a directory of local retail establishments.

Louisville Company Offers Use of Offices for Church and Charitable Benefits

The Louisville Gas & Electric Company has offered to a number of local ministers and officers of benevolent organizations, the use of the offices of the company on Chestnut Street, near Fourth, for bazaars, sales of one kind or another, etc., and has agreed at the same time to provide the gas or electrical cooking and heating appliances necessary and the services of a porter, free of charge. No engagements have yet been made to turn over half of the first floor of the company's office, which can readily be spared for such occasions, but many appreciative acknowledgments are being received and it is a foregone conclusion that the good-will of the public for the company has been increased as a result of the offer.

Shelling Nuts with Motor-Driven Blower

C. E. Sedgwick, manager of the Salino (Cal.) district of the Pacific Gas & Electric Company, has made a novel application of a No. 0 Sturtevant exhaust fan belted to a 1-hp. motor, to the hulling of almonds. The shells of these almonds could formerly be removed by hand only with the greatest difficulty, and the motor-operated method of hulling was suggested when one youngster who had been tediously shelling the "stick-tight" nuts by hand, in a fit of despair, hurled a particularly "tight" nut against a nearby wall, when—off popped the shell! This unexpected result at once suggested a method of hulling the nuts by motor power, and a centrifugal blower was proposed to perform the "throwing" of the nuts. As finally arranged, the nuts are fed into the suction side of the fan, where they are picked up by the runner and hurled against the fan casing, later being blown out of the discharged pipe into a box. The outfit takes about 3 kw., costing at the 8-cent lighting rate only 24 cents an hour. The owner of a 20-acre almond orchard on which this huller has been used declares that the equipment has saved him at least $10 a day.

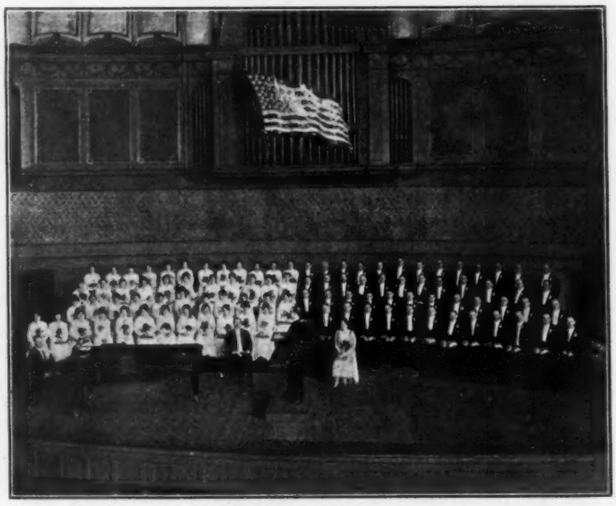
How a Community Accepts an Electric Company's Choral Society

Less than two years ago—on June 16, 1914, to be exact—the Commonwealth Edison Choral Society gave its first concert. On April 26, 1916, its third concert was offered. The society started with about fifty voices and now has more than 100. Its aim has been to provide its members with an interesting variety of preliminary musical study, and at the same time to engage the serious attention of the music-loving element among their friends in the Edison company.

That the society has gone far toward accomplishing its aim, that it has made itself felt in local musical circles, and that the good it has done has been reflected to the company which sponsored it, seems to be indicated by the favorable press comment which followed the last concert.

In the Chicago *Daily Tribune* Felix Borowski said: "Choral music and solo songs were presented by the Commonwealth Edison Choral Society at Orchestra Hall last evening. So extensive was the interest of the public in this entertainment that the house practically was sold out.

"While the Commonwealth Edison Company is not primarily devoted to the business of shedding light upon the pathway of art, there can be no doubt that it is accomplishing artistic work of considerable importance. An organization which maintains a symphony as well as a choral society deserves the respect of people who ask passionately that music be made the means by which that which they call the 'uplift' shall be carried to those who work for their daily bread. The labors of both the orchestra and the chorus have been demonstrated in Orchestra Hall. Without making unjust comparisons between them and the professional or semi-professional organizations which invite the attention of the town, it must be declared that the achievements of the company's musicians merit hearty commendation."



THE COMMONWEALTH EDISON CHORAL SOCIETY

Practically every other Chicago paper carried comment of similar vein. The society concerts have been given under the direction of Alfred G. Wathall, conductor, and Harold Wright, manager.

One Way to Get Publicity for Things Electrical

A recent Sunday issue of the Dayton (Ohio) *Journal* contained a story entitled "Daytonian's Home Is Electrically Operated from Top to Bottom." The story contained six pictures, three of which showed things electrical, and occupied a space five columns wide by 14 in. deep.

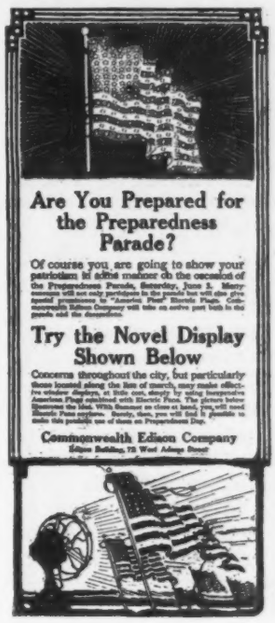
To purchase a space of such size would put a rather uncomfortable burden on the average central station's monthly advertising appropriation. "But why spend money for something you can get free?" said a man who knows how the newspapers scour their communities for stories that will interest their readers. "If there is an electrically operated home in your town, and you can get pictures of its labor-saving kitchen and the electric fireplace or other interesting views the job is half done. It can be completed by offering the pictures to your friend, the newspaper man, and 'selling' him the idea that his readers are interested in things which save labor electrically. By combining that idea with your pictures and his ability to write he can make a story helpful to his paper and helpful to the electrical interests of the city."

Flood Lighting the Red-Brick Courthouse at Plymouth, Mass.

During a recent celebration held in the historic Pilgrim city of Plymouth, Mass., to commemorate the opening of a "white way" consisting of thirty-five ornamental luminous-arc lamps, a feature of the evening program was the illumination of the courthouse and the tower of the new Federal Building by flood-lighting projectors. Ten of these flood-lighting units were used to illuminate the courthouse, two being installed to light the tower and eight to light the face of the building. As the building is made of red brick with white trimmings, the resulting effect was very beautiful.

THE WHITE STONE TRIMMINGS OF THIS RED-BRICK COURT HOUSE SET OFF THE STRUCTURE ATTRACTIVELY UNDER PROJECTOR-LAMP ILLUMINATION

A Patriotic Use for the Electric Fan



Just prior to a recent national holiday the Commonwealth Edison Company showed in its advertising a picture of a typical patriotic window display in a mercantile establishment in which an electric fan was producing a miniature hurricane to whip the American flag across the show window. The text of the advertisement told how such an attractive window display could be arranged and suggested that since summer was so close at hand and electric fans would be needed anyhow, the immediate purchase of a fan for window display purposes would be a good investment. It has been suggested that the same type of advertising could be used just prior to the Fourth of July, when merchants are again casting about for patriotic window-display suggestions.

How a Substantial Revenue Is Obtained from Breakdown-Service Customers at Clinton, Iowa

Thomas Crawford, general manager of the Clinton (Iowa) Gas & Electric Company, has adopted a liberal policy for connecting up customers for breakdown service, which is resulting in a substantial revenue return. The demand charge is waived and a meter charge of 75 cents a month is made instead, the customer having the privilege of throwing his plant onto the company service any time except during the peak-load period, and even this restriction has not been enforced. The latter reservation was included simply to have it in writing in case it should be necessary to have it observed at some later date. The customer buys his own transformers and arresters in some instances, and in others the company provides them, but in either case, since no charge is made for iron losses, the company makes use of the transformers for other load in the vicinity. This, of course, means that when the big customer comes on the transformer may be overloaded for a period, but to no harm.

By this policy, which makes breakdown service easy to get and with practically no charges attached, Mr. Crawford says he has connected customers whom he would not have been able to get otherwise. And with the service available these same customers with plants of their own, have each used from $150 to $500 worth of energy a month, which is income that the company could not have had if the demand charge had been insisted upon.

Moreover, with the service at hand and satisfactory, these same customers soon begin to need more capacity than their own plant provides, and instead of buying additional generating equipment, they simply take more power from the central station company. And so it works out that with the wearing out of the isolated plant the company will eventually supply the entire electrical requirements. Energy is sold to the industrial plants on a straight kilowatt-hour rate of 10 cents, with a sliding-scale discount ranging with the consumption from 15 per cent to 55 per cent.

Building a Range Load in a Kansas Town of 3500

How a Municipal Plant Has Worked to Develop the Popularity of Electric Cooking—The Range as a Day Load at McPherson, Kan.

In these days of intense interest in the development of the electric cooking business, the experience of the water and electric department of the city of McPherson, Kan., is most noteworthy. McPherson is a community of 3546 population and for two years the local municipal plant has been endeavoring to build up its electric cooking business, with the result that already the electric range load has grown to four-fifths the volume of the industrial power, demand, with a total output for the year 1915 of 16,301 kw. and a resultant income of $656.64. The story of how this was achieved is told by Miss Ellen Lunstrum, city clerk, as follows:

"It was in December, 1914, that Arthur Groesbeck, superintendent of the water and electric department, commenced the agitation of this question of electric cooking, with a view to the upbuilding of the day load on this plant. He soon succeeded in getting one of the local contractors to become an agent for the Hughes range, and a joint campaign of advertising and demonstration was begun. The services of a very competent demonstrator were secured for a week to demonstrate the ranges, as we felt that this was the only way of getting the proposition before the public and of showing the many advantages of the modern way of cooking with electricity as compared with the old way. Approximately 500 people attended our demonstration and eight ranges were sold at that time.

Advertising with Motion Pictures

In connection with our advertising campaign we secured several reels of picture films from electrical manufacturers, which were run at the Electric Theater, free to the public, showing the many disadvantages, trials and tribulations of the housewife cooking with coal, and the comfort and happiness afforded by changing from the old-fashioned way with all its dirt, soot, bother and delay, to the clean and economical method of cooking with electricity. We used considerable space in the daily papers, circulated handbills over the entire city, and used inserts in mailing out our monthly bills.

"As the cooking load is very essential to us for the improvement of our load factor, it is continually being solicited by means of advertising and personal work of the employees of the department and also by the local dealers handling the ranges. The idea is to keep this matter before the public at all times and in such a way that they cannot help but see the advantages. When houses are wired we impress upon the owner the importance and necessity of having provision made for an electric stove and other electrical appliances which he cannot afford to do without.

"We do not send out salesmen, for we find that we can obtain results in other ways. Our satisfied customers—and they are all satisfied—are our best advertisers and the greater number of ranges have been sold in this way in connection with the personal work of our employees. In a town of this size most of the employees take part in all the social life of the community and they have numerous opportunities to present to the people the advantages of this class of service. Our people are very much pleased with the results of municipal ownership and the business men especially are with us in everything for bettering the service and increasing the load."

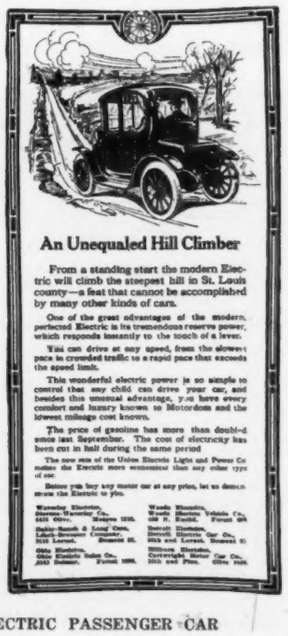
On Jan. 1, 1915, a cooking rate was established in McPherson of 4 cents per kilowatt, with a minimum charge of $1 per month. As this class of service proved so satisfactory to both the department and the consumers, the rate was reduced on Jan. 1, 1916, to 4 cents per kilowatt for the first 50 kw. and 3 cents for all above 50 kw., with the minimum charge the same as before. At the same time people not having electric ranges and desiring to use electric irons, toasters, fans and other electrical appliances can obtain the advantage of the 4-cent rate by having a separate meter installed, the minimum charge being the same. Every possible effort is being put forth to build up the day load by the sale of motors, stoves, irons, fans and all the other devices, and gratifying progress is being made.

Rockford (Ill.) Contractors Give Material Recognition of Benefit from Central Station Advertising

A consistent advertising program to secure the wiring of houses for electric service is being carried on by the Rockford (Ill.) Electric Company, and all wiring contracts secured from this source directly or through the soliciting salesmen are turned over to five contractors. Although the contractors do no advertising of their own, they naturally reap material benefits from the advertising done by the central station company, both in contracts secured through the latter and in jobs which come to them directly. In recognition of these benefits an agreement has been made with the contractors individually, whereby they pay to A. C. Martin, commercial manager of the Rockford Electric Company, a sum each month equal to 2½ per cent of the gross house-wiring business done that month. This money is not used to defray a portion of the central station advertising cost, but rather to buy additional space to what the company regularly uses for the purpose of publishing to readers in constantly increasing number the slogan "Wire Your Home."

Co-operative Electric Vehicle Advertising at St. Louis

Always Ready
There is great satisfaction in having a car that is always ready to go, regardless of the weather or other conditions. Buy an Electric and you will enjoy this extra advantage
The modern, perfect Electric never fails to start when you want it to, and when you start it you are sure of getting back home again without any unforeseen delays
The Electric is free from mechanical complications. There is nothing about it to get out of order and delay you until a mechanical expert can come and remedy the trouble
Furthermore, the Electric is an embodiment of style, luxury and comfort, and it costs less to run than any other type of car.
The new rate of the Union Electric Light & Power Co. makes the mileage cost of the Electric much lower than that of the cheapest gas car made
Any of the following dealers will be glad to demonstrate the superior merits of the Electric.


An Unequaled Hill Climber
From a standing start the modern Electric will climb the steepest hill in St. Louis county—a feat that cannot be accomplished by many other kinds of cars.
One of the great advantages of the modern, perfected Electric is its tremendous reserve power, which responds instantly to the touch of a lever.
You can drive at any speed, from the slowest pace in crowded traffic to a rapid pace that exceeds the speed limit.
This wonderful electric power is so simple to control that any child can drive your car, and besides this unusual advantage, you have every comfort and luxury known to Motordom and the lowest mileage cost known.
The price of gasoline has more than doubled since last September. The cost of electricity has been cut in half during the same period
The new rate of the Union Electric Light and Power Co. makes the Electric more economical than any other type of car.
Before you buy any motor car at any price, let us demonstrate the Electric to you.

PUBLICITY FOR THE ELECTRIC PASSENGER CAR

Above are reproduced two of a series of twenty co-operative advertisements run in St. Louis newspapers during the year. The subscription fund collected by the local electric vehicle organization totaled $1,655.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Three-Conductor Electric Cables

Explanation of the Fact that the Dielectric Loss Occurring in Single-Core and Three-Core Cables Follows Different Laws Suggests a New Design for High-Tension Three-Core Cables

IN our issue of Feb. 12, 1916, an abstract was given of an interesting German paper by M. Hoechstaedter on three-core cables. As the subject is of considerable interest and also of practical importance, the publication of a rather full English translation of this paper in the London *Electrician* of May 19, 1916, gives us a welcome opportunity to take this subject up again in greater detail. It is a fact that in ordinary single-conductor cables the dielectric loss varies with the square of the voltage, while in three-conductor cables it varies with a higher power of the voltage. What is the reason of this difference which at first glance is an anomaly? Hoechstaedter traces it to processes occurring in the interior of a three-core cable when exposed for long periods to a high voltage.

Fig. 1 shows a section through a three-core cable of the usual construction. (A special spiral of copper is shown in the interior of the central insulation; this was used for certain tests to corroborate the author's theory, but may be neglected in reading the following account.) The directions of the lines of force are shown for a given instant, assuming three-phase power to be applied. The voltages in *a* and *c* are equal and opposite and half the value of the phase voltage in *b*. The insulation round the conductors and up to the lead covering is supposed to be homogeneous. It is evident that the four wedges of jute are submitted to a considerable electric stress. Both at the outer layers and also inside the active insulation there are various points where the electric stress acts tangentially to the layers or dividing surfaces.

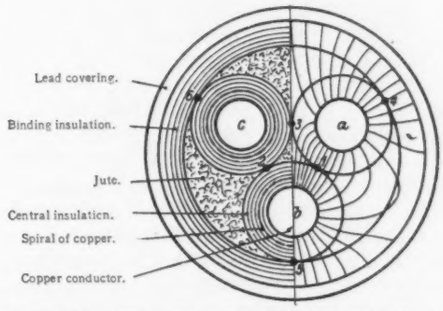


FIG. 1—ELECTRIC FIELD FOR THREE-CORE CABLE OF USUAL CONSTRUCTION

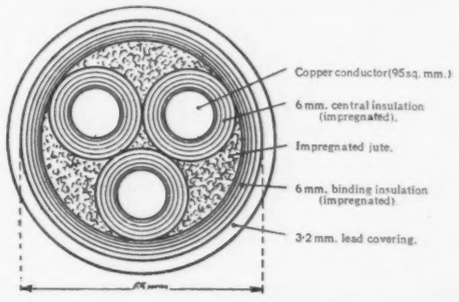

Copper conductor (95 sq. mm.)
6 mm. central insulation (impregnated).
Impregnated jute.
6 mm. binding insulation (impregnated).
3·2 mm. lead covering.

FIG. 2—SECTION OF A THREE-CORE POLYPHASE CABLE OF USUAL CONSTRUCTION

Between any two of the conductors *a b* and *c* the voltage is 1.73 times the voltage *e* between the conductor and earth. In the space between the three conductors there exists an electrostatic polyphase field. The central point *O* of the section will have a potential about equal to that of the earth. Between it and each conductor will therefore be the phase voltage *e*. As a result of this, and under the assumption that the bounding surfaces are good insulators, the voltages between the points 1, 2 and 3, and the neutral point amount to 0.87*e*. The voltages between the points 1 and 2, 2 and 3, and 3 and 1 amount to 0.5*e*. The voltage between the point 5 and the conductor *b* is about 0.66*e*.

Over the very short path 1-3, which is about equal to the thickness of the central insulation, there is a voltage of about 1.5*e*. And it is plain that under a high voltage the wedge 1, 2, 3 cannot withstand this stress. In consequence of these voltages equalizing currents will be set up. These currents try to equalize the voltages in the wedges 1, 2 and 3 so that the whole wedge tries to reach the potential of earth. Also between the points 1 and 5 there is a voltage of about 0.44*e*, as can easily be seen from the diagram. The creeping path 1-5 is about twice as long as 1-3, so that the path 1-5 is able to hold out, even if 1-3 gives in. But if the path 1-3 yields the stress on the path 1-5 automatically increases and approximates to the value 0.66*e*. At a higher voltage the path 1-5 will also be unable to resist the stress; therefore, the outer wedges and the "girdle" insulation will tend to the voltage of earth. At the same time the surfaces of the central insulation will assume the character of equipotential surfaces. The points 1, 2, 3, 4, 5, 6, 0 have, therefore, in this case no differences between them. The central insulation of all three conductors has under normal conditions, to withstand the whole of the phase-voltage. The tangential voltages disappear except in so far as they are necessary to the residual equalizing currents.

Thus we see that the processes which go on inside the cable have ultimately the effect of making the cable electrically into a mechanical combination of three single-conductor cables. But there is this difference; the outer coating is not that of metallic surfaces, but is that caused by the slow effect of the glow discharges, which tend to destroy the material; the value of the "girdle" insulation is thus almost completely lost, while the central insulation is overloaded. The voltage in a three-core cable, at which there is a displacement of the inner voltage distribution, may for our purposes be called the "limiting" voltage. Now, this displacement of the voltage distribution within the cable is necessarily accompanied by an increase in the total dielectric loss.

In view of these facts it is only possible to regard the usual construction of three-core cables as unsuitable for voltages above the "limiting" voltage. From the operative point of view, this is also the case; above the "limiting" voltage, such a cable is exposed to an internal destructive process, but its efficiency is also lowered owing to increased dielectric loss.

Ordinary three-core cables, therefore, seem unsuitable for very high-pressure work; and yet it is not difficult to see how the design of such cables could be improved. Fig. 2 shows the section of a three-core cable of the usual construction for polyphase work; it has conductors of sectional areas of 95 sq. mm., and a thickness of 12 mm. of insulation. The cable is intended for a working voltage of 25,000. In Fig. 3 a new form of construction is shown; the whole of the "girdle" or binding insulation is omitted, and the various central insulating coverings are surrounded by a metallic coating. This metallic coating has naturally the effect of keeping the outer surfaces of the central insulation to earth potential. The metal coating has only to carry extremely small equalizing currents, and, therefore, their thickness can be kept as small as possible consistent with the requisite mechanical strength. The four wedges, which are necessary to fill out the spaces between the cables, can be made out of any kind of inferior material, which does not need to be impregnated; it has no kind of electric stress to withstand. The central insulations can be impregnated before being wound on, and can be bound round with a view to making them solid and compact; this can be done during the winding-on process.

As for dimensions, it seems desirable to make the central insulation about half as thick again as is shown in the old form of construction in Fig. 2. The calculated electrical data of the new cable are at least as good as those of the old one; it has the same external diameter, and is much lighter. The metallic coverings, which are added to the insulation about the different conductors, prevent the destructive processes which have been described above, even at very high voltages. The metallic coverings of the various cores touch the lead coating, and are in frequent metallic contact with it; so that in cases where the operation is unsymmetrical, as, for instance, if one phase is earthed, the equalizing currents pass through the lead covering.

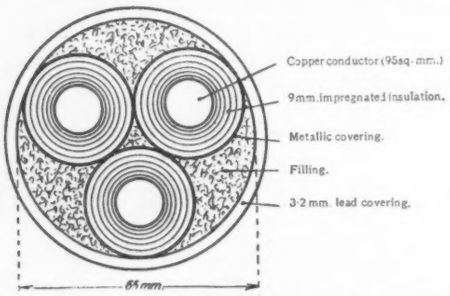


FIG. 3—A NEW CONSTRUCTION FOR THREE-CORE CABLE

The two cables, Figs. 2 and 3, have exactly the same working capacities. Below the "limiting" voltage, the two cables have the same dielectric loss; for higher voltages the cable of Fig. 3 has lower losses and higher efficiency. As to breakdown voltage a distinction must be made between the "continuous" breakdown voltage and the "momentary" breakdown voltage, the former being usually much lower than the latter. With respect to the "continuous" breakdown voltage, the cable of Fig. 3 is superior to that of Fig. 2, because the internal destructive processes are entirely avoided. Above the "limiting" voltage, the new cable is in all respects superior with respect to breakdown voltages of both kinds.

The amount of copper and lead in the two cases are the same. There is a saving in paper of 12 per cent, and more than 33 per cent in the impregnating material. This, as well as the omission of the "girdle" or binding insulation and the reduction in the time required for impregnation, makes the new cable much cheaper and lighter. There is more jute or other filling material required, but this makes little difference, especially as the filling for the new cable can be made of quite cheap materials. The cost of the metallic covering for the different insulations about the conductors is very small and of no importance as compared with the total cost of the cable. The new type of cable seems, therefore, to have advantages quite apart from electrical considerations, and it is also cheaper and lighter.

Generators, Motors and Transformers

Transformer Design.—F. M. DENTON.—In the conclusion of his long illustrated mathematical serial on transformer design, the author gives an outline of the design of a 500-kva., 50-cycle, 6600 to 440-volt star-connected three-phase transformer.—London *Electrician*, May 12, 1916.

Brushes for Commutators and Sliprings.—CHARLES H. SMITH.—An article dealing with the composition of brushes, their selection, application and care, lubrication and cost.—*Elec. Journal*, June, 1916.

Lamps and Lighting

Illuminating Engineering Research.—The Research Committee of the British Illuminating Engineering Society has issued a list of subjects deserving research. These are classified under the following headings: (*a*) Photometry, standards of light and researches on color; (*b*) electric, gas and other illuminants; (*c*) lighting appliances; (*d*) general. In connection with subjects of importance from the industrial standpoint, the committee suggests that priority should be given to investigations relating to the development of lamps and lighting appliances, and researches having for their object the elucidation of general problems on which the development of the lighting industry depends. As an instance, the investigation of the properties of illuminating glassware should receive immediate attention at the hands of a special sub-committee appointed for the purpose. Another subject which merits early attention in view of its relation to the dyeing and coloring industries is the preparation of a standard series of colors, and in particular of a standard white surface, suitable for acceptance in all researches in which the accurate definition of color is involved. Conjointly with this subject, the design of suitable apparatus for analyzing and specifying color and for measuring the reflecting power of various materials should receive attention. There is also the further problem of providing a fixed standard for the permanence of colored materials. Among other matters which, in view of their important bearing on the future development of lighting, deserve special attention, may be mentioned the study of glare and the limits of permissible intrinsic brilliancy, the investigation of the comparative effect on vision and the physiological influence in inducing fatigue of natural and artificial illumination, and of various systems of artificial lighting, and the conditions, as regards the intensity of illumination and arrangement of lights, desirable for various industrial operations.—London *Electrician*, May 19, 1916.

Installations, Systems and Appliances

Meter Tariff Versus Flat Rate for Small Consumers.—IHLEFELD.—The main objection against using meters for small consumers has been the cost of interest and amortization of the meters and the cost of taking readings and making out bills. But the author points out that in recent years the construction of meters has been greatly improved and cheapened, and with a life of twenty years the interest and amortization charges are not prohibitive for small consumers. In order to reduce

the cost of taking readings and making out bills, the author recommends the following system: He proposes to estimate in advance what the consumption during the year may be and let the consumer make twelve equal payments in twelve months of the year accordingly. At the end of the year the meter is read once and a correct bill is made out, and either an excess charge made to the consumer or a refund made according to the meter reading. The author points out the disadvantages of any flat rate with or without current-limiting devices.—*Elek. Zeit.*, March 2, 1916.

Current-Limiting Reactors.—H. H. RUDD and W. M. DANN.—Current-limiting reactors are designed to limit to a predetermined value the current that can flow when a short-circuit occurs in alternating-current circuits in which they are placed. The authors discuss the protection provided, the rating of reactors, their location, the amount of reactance required for protection, and the effect of such reactances in giving a slightly poorer regulation and increased losses.—*Elec. Journal*, June, 1916.

Starting Rheostats.—F. CAMPANAKIS.—Two mathematical articles on the calculation of starting rheostats. The author discusses the maximum possible capacity which is obtainable with resistance coils of different arrangements.—*La Lumière Elec.*, Feb. 26 and April 22, 1916.

Lightning Arresters.—R. P. JACKSON.—In the long serial on the engineering evolution of electrical apparatus the history of the lightning arrester is completed. —*Elec. Journal*, June, 1916.

Electrophysics and Magnetism

Filaments Heated Electrically in Volatile Liquids.—S. W. J. SMITH.—The author, repeating some experiments by Addenbrooks and Crawley, discovered a striking phenomenon, viz., a bubble is formed on a wire immersed in the liquid and moves along the wire to and fro, and if there are loops in the wire it "loops the loop" in a curious way. This happens, for instance, with a 100-volt lamp filled with paraffine oil when used as a resistance in a 200-volt circuit. Benzine, turpentine and aniline oil may also be used. The currents necessary for the production of the bubble and for its maintenance are higher the higher the boiling point of the liquid. This suggests that the bubble consists of vapor of the liquid. The motion of the bubble is not affected by altering the direction of the current. It is produced equally well by alternating current. It is thus apparently of thermal origin. It would seem that the bubble exists in a region of which the temperature changes rapidly in the direction perpendicular to the wire.—London *Electrician*, May 12, 1916.

Units, Measurements and Instruments

Measuring the Phase Difference of Condensers.—H. L. DODGE.—A brief abstract of an American Physical Society paper. When an alternating emf. is impressed upon a condenser the resulting current does not lead the emf. by the theoretical 90 deg. This is particularly noticeable in the case of paper condensers of the telephone type often used in laboratories for experiments in connection with the study of the alternating-current circuit. When an attempt is made to interpret such experiments by graphic methods it is sometimes found that the power factor of the condensers is so great that it must be taken into account. The angle by which the current lags behind the theoretical 90 deg. lead is known as the phase difference of the condenser. It is possible to determine this angle from data obtained in the experimental study of current resonance. A coil of inductance and resistance is arranged to be connected in parallel with a number of paper condensers of nominally equal capacity. An alternating emf. being applied, the values of the total current, the coil current, and the condenser current are read as the condensers are introduced one by one. The coil current will remain constant, the condenser current will increase uniformly, while the total current will decrease, pass through a minimum value and then increase. If one chooses several sets of these values and constructs the vector diagram of currents, he will find that if the phase difference of the condensers is to be zero the minimum total current must be exactly equal to the projection of the coil current upon the voltage axis. As a matter of fact, the minimum total current will be found to be larger by an amount which varies with the magnitude of the phase difference. To obtain the phase difference proceed as follows: Draw the voltage axis. From the constants of the coil determine the angle by which the coil current lags behind the voltage and plot to scale the vector representing the coil current. With the origin as a center and a radius equal to the minimum value of the total current describe an arc reaching a short distance each side of the axis of reference. From the extremity of the coil current vector draw a line tangent to this arc. The angle which this line makes with the reference axis is the power factor angle of the condensers. The difference between this angle and 90 deg. is the phase difference of the condensers.—*Phys. Review*, May, 1916.

Miscellaneous

Locating Bullets by X-Ray.—A demonstration of a new X-ray apparatus was made recently in Munich by A. Hasselwander, who has used the apparatus successfully in field hospitals on the west and east fronts. Two photographs are taken from two separate X-ray tubes, the cathodes being placed at a distance apart equal approximately to the distance between the human eyes. A stereoscopic picture of the bullet or other body and its surroundings is then obtained, which, when viewed under the correct conditions, gives a correct idea of the location, form, etc., of the body. The apparatus developed by Hasselwander enables the stereoscopic picture to be recorded automatically in all three dimensions of space in an exact scale of measurement, so as to give a permanent record of the case. An instrument used in land surveying, and known as a stereoplanigraph, is employed for the purpose. The two stereoscopic photographs are viewed by means of mirrors so lightly silvered that one can see a small source of brilliant spot of light behind the mirrors; that is, where the stereoscopic and apparently solid image appears to be. This spot of light is then moved about in all three dimensions of the space apparently occupied by the image, and can be placed so as to coincide with any part of the bullet or other foreign body or its surroundings, and the position in space relative to any fixed point permanently recorded by means of the stereoplanigraph to which the bright spot is attached. An automatic modeling of the image is said to be possible by attaching to the bright spot a stiff needle, which then will follow the movements of the bright spot in all three dimensions, and can be made to reproduce the form of the image in a solid material in the same manner as can be done with a sculptor's point-pantograph for reproducing a piece of modeling.—London *Elec. Eng'ing*, May 11, 1916.

Bonus System.—R. RANKIN.—A long abstract of a paper read before the (British) Junior Institution of Engineers on "speeding up" in an engineering factory. The author discusses the logical basis of bonus systems of payment. The results obtained with the system adopted and the difficulties encountered are described.—London *Electrician*, April 28, 1916.

P. S. MILLAR

Preston S. Millar, who contributes to this issue a discussion of present-day opportunities open to the young electrical engineering graduate, in laboratory and research work, is the general manager and secretary of the Electrical Testing Laboratories, New York City, with which organization he has been identified for twenty years. He is a past president of the Illuminating Engineering Society, and recently also served as secretary-treasurer and business manager for the committee on organization of the 1915 International Electrical Congress at San Francisco, the plans for which were interrupted by the outbreak of the European war. Mr. Millar is active as a member and committee worker in many engineering and technical organizations, and has presented a number of important papers, lectures and committee reports before the American Institute of Electrical Engineers, the Illuminating Engineering Society, the National Electric Light Association, the Association of Edison Illuminating Companies, the American Association for the Conservation of Vision, the Association of Railway Electrical Engineers, and other bodies, besides being a frequent contributor to the technical press. With Dr. Clayton H. Sharp, Mr. Millar is co-inventor of the Sharp-Millar photometer, of a commercial form of integrating photometric sphere, and of a simplified form of illuminometer.

Noah Kennard has been appointed superintendent of the municipal electric lighting plant at Morehead, Ky., succeeding E. E. Maggard, resigned.

J. L. Moore, who has been with the Kerr Turbine Company as chief engineer for the last seven years, has severed his connection with that company.

T. I. Jones, general sales agent of the Edison Electric Illuminating Company of Brooklyn, N. Y., was married on June 7 to Miss O. V. Losee. Many electrical men from various parts of the country were in attendance. J. F. Becker, general sales agent of the United Electric Light & Power Company of New York, was best man, and E. W. Lloyd, general sales agent of the Commonwealth Edison Company of Chicago and past-president of the National Electric Light Association, was one of the ushers.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Kenneth Cummings of Eberts, Ont., has been appointed assistant chief engineer for the Marconi Wireless Company of Canada, with headquarters at Montreal.

J. C. Donald, general superintendent of the Asheville (N. C.) Power & Light Company, has resigned his position with that company, to take effect on July 1.

John H. Doherty, vice-president and general manager of the Corning (N. Y.) Light & Power Corporation, has been elected president of the Corning Chamber of Commerce.

George H. Graves, former assistant electrical engineer of the Sanitary District of Chicago, has been appointed head of the department, following the resignation of Edward B. Ellicott.

Fletcher A. Easton, who has been manager for the Midland Counties Public Service Corporation at San Luis Obispo, Cal., for several months, has been appointed traveling representative for the company.

Isaac H. Levin has resigned as chief engineer and chemist of the International Oxygen Company in order to devote his time to chemical research and as a specialist in the electrolytic field. His temporary address is 186 Hillside Avenue, Newark, N. J.

W. B. Whitehorn, purchasing agent and assistant to the president of the Omaha Electric Light & Power Company of Omaha, Neb., has resigned to become secretary and manager of the National Oil & Paint Company. Mr. Whitehorn has been with the Omaha company about seventeen years. He will be succeeded as purchasing agent by B. P. Egan, formerly of Nebraska City.

D. S. Miller, who has been appointed manager of power and lines for the properties of the Reading (Pa.) Transit & Light Company and affiliated companies, was formerly supervisor of power and lines of the electric properties controlled by the New York, New Haven & Hartford Railroad Company, embracing electric railways in Connecticut, Massachusetts, Rhode Island and part of New York State. Mr. Miller was with the New York, New Haven & Hartford Railroad Company about nine and one-half years. He was graduated from the Pennsylvania State College in 1900, and served with the General Electric Company for one year in its testing department and on outside construction work; with the Sprague Electric Company, New York, one and one-half years as erecting engineer, and with the Boston (Mass.) Elevated Railway Company about three years as assistant electrical and mechanical engineer.

M. R. BUMP

Milan R. Bump, who resigned last fall as chief engineer of the Doherty operating organization to become vice-president of the Picher Lead Company, one of the principal zinc-producing corporations in the Joplin (Mo.) district, on June 1 returned to the Doherty organization at New York City, as chief engineer. Mr. Bump was formerly treasurer and general manager of the Empire District Electric Company of Joplin, a Doherty company which supplies energy to operate a large number of mines in the neighboring zinc fields. Mr. Bump attended the recent N. E. L. A. convention in Chicago, and, following the announcement of his return to the electrical industry, was appointed a member of the N. E. L. A. executive committee to serve for three years.

Roy Husselman, an electrical engineer representing F. W. Ballard of Cleveland, Ohio, has been retained by the board of water commissioners of Dunkirk, N. Y., to make a survey of the local electrical situation with the object of recommending whether or not it would be advisable for the city of Dunkirk to install new generating machinery in the municipal power plant or to buy power from the Niagara & Erie Power Company.

Obituary

Leslie S. Robertson, secretary of the engineering standards committee of Great Britain, was one of those who perished with Lord Kitchener at the time of the sinking of the cruiser Hampshire, June 6. Since its inception in 1900, Mr. Robertson had served as secretary to the committee which with its one hundred or more dependent committees and sub-committees now covers the whole field of engineering in Great Britain. Mr. Robertson was fifty-four years of age and had recently taken up a responsible position in the Ministry of Munitions. In the words of C. le Maistre, the representative of the British committee now in this country on standardization conference work, "Mr. Robertson's sterling qualities, versatile ability, genius for organization, and intimate knowledge of men and affairs, added to his charm of manner, make his loss to the engineering standards committee irreparable."

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Protective System for Service Connections

A protective system for consumers' service connections, called the "Noark Universal" system, which embodies, besides the service switch and cut-out, a protective cabinet, meter, adapter and facilities for testing the meter and for easily disconnecting the circuit in case of discontinuance of service, has been brought out by the H. W. Johns-Manville Company, New York. In this system the various parts have been so standardized, it is claimed, that the cost of installation and maintenance has been reduced to a minimum. With a supply of base-block units, protective cabinet, meter adapter, load-side device support and switch handle, service connection appliances of any desired character, it is pointed out, may be made up as required. Switches may be fused or unfused and changed into meter-testing switches; meter-testing and connection blocks may be arranged also to serve as switches; two-pole devices may be changed into three-pole, etc. Protection against tampering and theft of current, flexibility, durability, ease of installation, foolproof construction, and interchangeability of parts are some of the advantageous features of the system to which the manufacturer directs particular attention. In the accompanying illustrations are shown five types of units employed in the system.

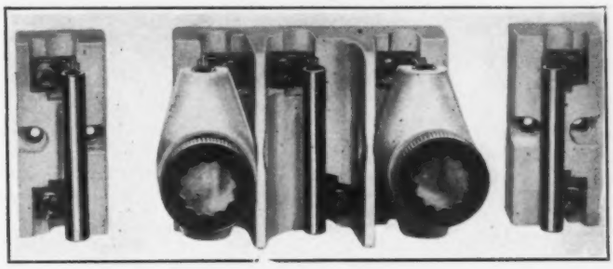


FIG. 1—LEFT AUXILIARY OR SINGLE-CONNECTOR, THREE-CONNECTOR AND RIGHT AUXILIARY OR SINGLE-CONNECTOR BASE-BLOCK UNITS

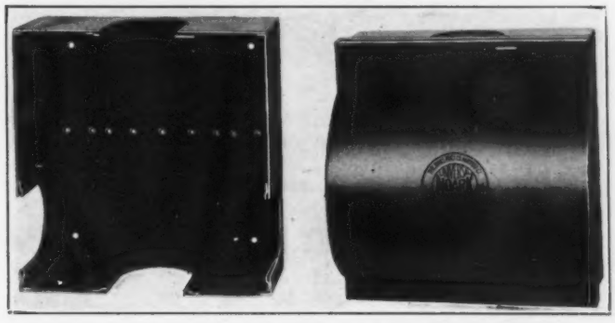


FIG. 2—EXPLODED VIEW OF SEALABLE CABINET

A single element or member of a "Universal" appliance may be arranged to serve for switch, cut-out or meter-testing purposes. This three-in-one service is of great advantage, it is declared, inasmuch as it results in the elimination of more than 50 per cent of the contacts which have heretofore been necessary, where distinct and separate devices performed these three functions. This triple functioning is made possible, due to the fact that the link that served as the switch arm also carries the fuse, so that but a single pair of contacts is used; furthermore, this same switch arm can also be utilized as the meter-testing link, or member. This is made possible because of the fact that the switch handles are arranged so that they can either be mechanically coupled to the movable connectors or uncoupled therefrom. When coupled, the connectors serve as switch members, and when the handles are uncoupled each connector becomes individually movable for meter-testing purposes.

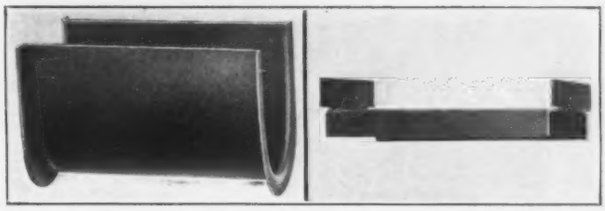


FIG. 3—TROUGHS FOR CONNECTING CABINETS

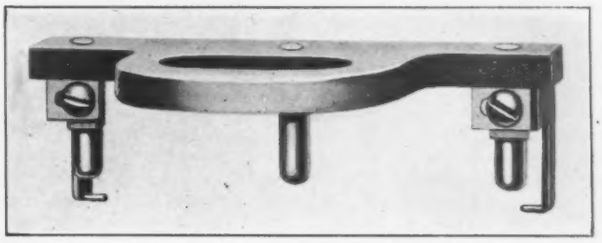


FIG. 4—DIRECT SWITCH HANDLES

In Fig. 1 is shown some of the typical unit base blocks

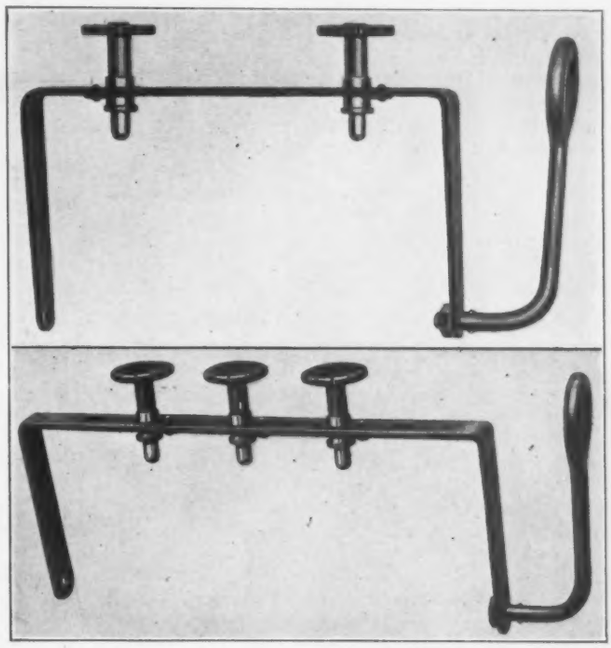


FIG. 5—EXTERNAL SWITCH HANDLES

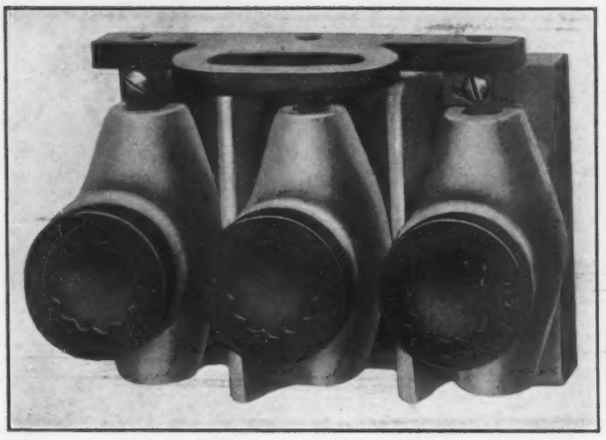
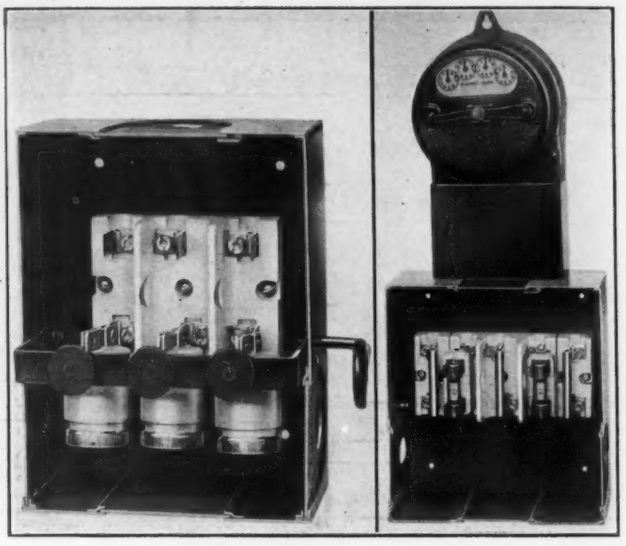


FIG. 6—THREE-POLE, PLUG-FUSED SWITCH WITH DIRECT SWITCH HANDLE



FIGS. 7 AND 8—THREE-POLE, PLUG-FUSED SERVICE ENTRANCE SWITCH AND INCLOSED SERVICE CONNECTION AND METER-TESTING CUT-OUT BOX

from which assembled cut-outs, knife switches, meter loops and many other combinations may be derived. These blocks are adaptable for plug, link or cartridge fuses and can also be jumpered by the copper tubular straps shown. It is interesting to note that the type of base block clips and the spacing vary exactly as the amperage progression for N. E. C. fuses. An exploded view of the sealable cabinet is shown in Fig. 2. The cabinet is slotted to receive slides, which may be blank or perforated, so as to receive either rigid or flexible conduit of any size. With the latter arrangement it is possible to enter the cabinet from either side or from the bottom. The meter adapters are so constructed as to conform with any style of meter. The adapters are locked fast to the cabinet by closing the cabinet lid and can be instantly removed when the cover is open. When two or more cabinets are placed side by side, the wiring trough shown in Fig. 3 is employed. The flat punching is the trough proper and the semicircular punching fits over this, making a closed duct for wiring, each end of which is firmly secured by the cabinet cover.

Another interesting innovation in this system of devices is the external operating handle which can be attached to any cabinet and to the cut-out apparatus inside the cabinet, giving the latter the function of a fused-knife switch. These handles can be arranged to operate either two or three poles and can be instantly detached when testing makes this desirable. Another type of switch handle is utilized to perform the same switching function from the inside of the box just as in the case of the ordinary knife switch. Fig. 6 shows a three-pole 0.30-amp., plug-fused system provided with this type of handle.

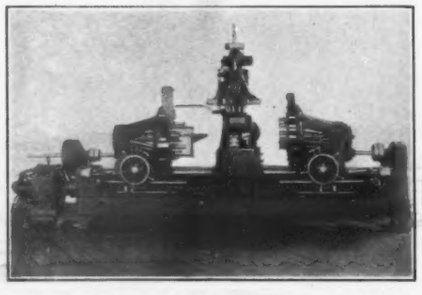
Some examples of assembled devices are shown in the illustrations herewith. In Fig. 7 is illustrated a three-pole 0.30-amp., plug-fused service entrance switch. Fig. 3 shows a three-pole inclosed fused (solid neutral) service connection and meter-testing cut-out box with meter adapter. The devices are being made with ratings up to 400 amp. inclusive at pressures of 125 volts or 250 volts.

Multiple-Spindle Drilling Machine

For drilling all the holes in an automobile transmission case at one setting the Baush Machine Tool Company of Springfield, Mass., has developed the multiple-spindle drilling machine shown in the accompanying illustration. This machine is unique in that there are forty-six holes in each transmission case and the drilling is done regardless of the fact that some of the holes are on an angle and vary in size from 3/16 in. to 1 11/16 in. Each drill runs at the same speed and each group of drills has independent feed.

The machine is operated by a 25-hp. 230-volt, 1400-r.p.m., commutating-pole, direct-current, Westinghouse motor, through a main driving shaft placed at the rear of the machine, connected to the horizontal heads by steel gears and cloth pinions, and connected to the vertical head by bevel gears. The motor operates equally as well in either direction of rotation and can be reversed without changing the position of the brushes.

The bed of the machine is supported on feet, providing ample space for cleaning under the machine and preventing the floor from becoming water-soaked if drilling compound is used. All reciprocating parts are inclosed in cast guards, effectually protecting the operator from injury. Various spindle speeds are obtained through gear reductions incased in oil-tight boxes on the heads. The spindles are equipped



MOTOR-DRIVEN MACHINE FOR DRILLING ALL THE HOLES IN AUTOMOBILE TRANSMISSION CASE

with ball-thrust bearings, and Baush universal ball joints. An improved type of arm allows a center distance between holes equal to the diameter of the spindle. The spindles may be adjusted for different lengths of drills by operating but one screw at the outer end of the arm. The horizontal heads have standard, belt-driven feed with automatic control and quick traverse by hand wheel. The vertical head and cluster-box slides are automatically controlled by a left-hand head through a trip rod and bell crank which operates a jaw clutch on reversing gears in the gear box. These gears control the shaft operating the pinion and racks attached to the vertical head and slide.

In operation the left-hand head is brought forward, automatically engaging the feed of the vertical head and cluster box slide, which travel the required distance and automatically return to the neutral position. The feed for the right-hand and left-hand head is then engaged by levers. At the same time a spindle on the box jig drills the hole. The feed is automatically tripped by stops and the heads return to the neutral position, completing the operation.

Time Switch That Controls Any Combination of Two Circuits

A time switch which can be so set as to control two separate circuits, and cut them on and off together or separately at any predetermined time, has been placed upon the market by Kerwin Brothers, Oelwein, Iowa. It is equipped with a twenty-four-hour dial and the adjustment of the tripping hand is ac-

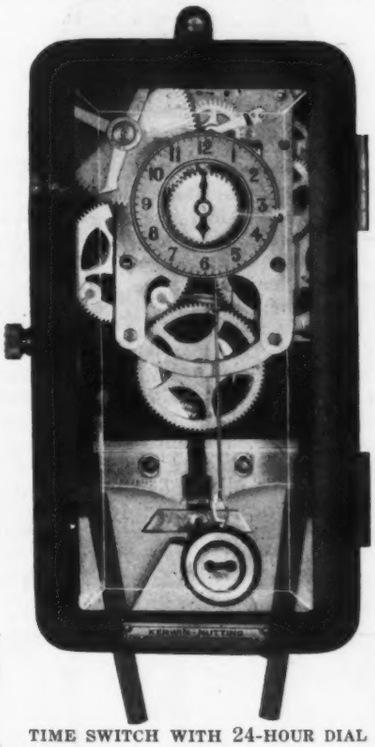
complished by the fingers, no wrench, screwdriver or other tool being necessary. The mechanical selecting device adapts its use to the diversified needs of various business conditions, and is said to be very simple of operation. It is fitted with a special "Perkins" switch which makes the break of electric current in a fraction of the time required by old-style construction, it is claimed. One of the features of the device is the two levers which project below the case as shown, by use of which the operation of the clock may be disconnected for any desired time. If, for instance, it is desired that either or both of the circuits controlled by the clock be not operated on a Sunday or holiday, it is simply necessary to move one or both of these levers between the contacts, cutting out the clock control. The original operation is resumed by merely throwing the lever back again.

The various combinations of control of two circuits are as follows:

1. A given circuit of light may be turned on at one time and off at another.

2. A given circuit of light may be turned on at a certain time, off at another given time, and later during the night this same circuit turned on and off again.

3. Two circuits may be turned on at a given time, for instance, the window lamp and the all-night lamp, or the electric sign and the second window circuit lamp, and then one circuit



TIME SWITCH WITH 24-HOUR DIAL

turned off at a given hour, leaving the other burning until a later time.

4. One circuit can be turned on at a given time, the other at a later hour, and both turned off together.

5. One circuit may be turned on at a specified time and off at a later hour, and the other circuit turned on as the first is turned off, and this in turn switched off at a later time.

Trolley Poles Inside of Lighting Standards at Salt Lake City

One of the problems which had to be solved in connection with the new whiteway lighting system at Salt Lake City was that of erecting lighting standards on a street already occupied by steel trolley poles, without giving the street that unsightly appearance which two sets of steel standards generally impart. To solve this problem the trolley poles will be telescoped by large-sized pressed-steel standards similar to that shown herewith. The city has purchased seventy of these standards from the Union Metal Manufacturing Company of Canton, Ohio, which will be erected in the general business district. The pressed-steel standards are said to be the largest of this class which have ever been built. The dimensions of the units are as follows: Base diameter at ground line, 32.5 in.; height of base, 53 in.; base diameter of shaft, 14 in.; top diameter of shaft, 10 in.; height to light source of two lower lamps, 26.5 ft.; height to light source of top lamp, 28.75 ft., and height over all, 30.16 ft. The base of the lighting standard is

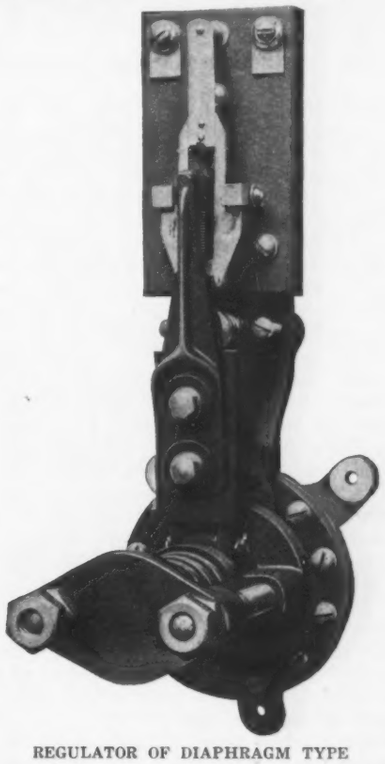
THREE-LAMP ORNAMENTAL STANDARD

made in several sections separated horizontally so that each can be easily telescoped over a tubular-steel trolley pole. After these parts are in place the next unit to be telescoped will be the pressed steel shaft, which is sufficiently light in weight to permit of the erection. Although in this particular case the standards serve as trolley pole castings, they are made with anchor and tie rods so that they may be installed independently of the trolley poles.

The energy for operating this system will be furnished by the Utah Power & Light Company. Each of the three lamps which surmount every standard will be of the luminous-arc type manufactured by the General Electric Company of Schenectady. Plain glass globes instead of ribbed glass, such as shown in the illustration herewith, which is used only to show the standard, will be used in this installation. The system was planned by W. D'A. Ryan illuminating engineer of the General Electric Company, in conjunction with the city engineer of Salt Lake City, and is similar to that designed by Mr. Ryan for the new Market Street installation in San Francisco as described in the ELECTRICAL WORLD of April 1, 1916.

Pressure Regulator

A pressure regulator, of the diaphragm type, designed for use with automatic starters on motors, pumps, com-



REGULATOR OF DIAPHRAGM TYPE

pressors, etc., is being made by the Westinghouse company, Pittsburgh. It requires only two wires to connect them to the starters and are designed for use in connection with compressors or pumps emptying into closed pressure systems containing air, gas, water or any fluid not injurious to the rubber diaphragm. The regulator can also be employed with pressure systems operated by oil or steam if a loop is introduced into the pipe leading to the regulator, to prevent the oil or steam from coming into direct contact with the diaphragm. The regulator consists of four essential parts, the pressure chamber, the operating arm, the switch lever and the adjusting springs. The pressure cylinder is of cast-iron, inside of which is a heavy flexible-rubber diaphragm. A piston attached to the diaphragm projects through the chamber and engages the operating arm which actuates the switch lever. The operating springs oppose the movements of the piston and the operating arm which actuates the switch lever, and can be adjusted to suit the requirements of the circuit on which the regulator is to operate.

Electric Passenger Cars

The latest types of electric passenger cars developed by the Walker Vehicle Company, 531 West Thirty-ninth Street, Chicago, Ill., have been termed "Edison models," since they have been designed

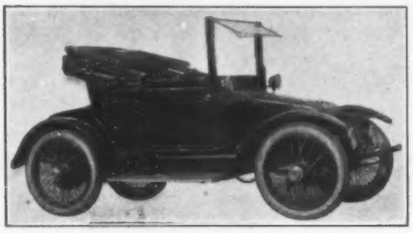


FIG. 1—ELECTRIC CABRIOLET ROADSTER

particularly for use with the new G-type Edison batteries, which are said to give considerable increase in power with reduced weight. The new cars include the Model 162, five-passenger vehicle, Model 163, four-passenger car, and Model 164, carbriolet roadster. The Model 162 car is provided with forward drive, and its body is 8 in. longer than that of the other models. The wheelbase of the car is 104 in., while the interior body length is 78 in. While unusual body length is found in this model, the manufacturer points out, the car can be turned completely within a radius of 38 ft. The No. 164 roadster is designed primarily as a utility car. The rear seat is wide enough to carry three passengers comfortably, while an auxiliary folding seat will carry a fourth person. The Model 163, four-passenger car, has rear-seat drive.

In the design of the new bodies, angles and sharp corners have been eliminated as much as possible. The arched doors have been modified to give a straight-line roof with only a slight arch perceptible over the door. Use is made of solid tires. Aluminum is employed exclusively for all parts exposed to the weather. The design of the chassis is similar to that of previous models, the frame being built into a rigid unit, adapted particularly to the use of solid tires. Marked improvements have been made in the lubrication of the cars, the manufacturer points out, particularly to the steering gear, the number of places requiring grease being reduced to a minimum.

A low-speed motor adapted especially for use with the new G-type Edison battery is employed to operate the new models. The control is of the continuous torque type with magnetic blowout, and is practically the same as that utilized on older models of "Chicago" cars. The controller is in a weatherproof metal case directly against the motor, thereby materially reducing the length of wiring. It is readily accessible through a door in the floor of the car. The controller system provides for five forward and reverse speeds, with brake operated by horizontal control lever, which is provided with a Yale lock. Speeds of 5 miles, 8 miles, 15 miles and 22 miles per hour can be obtained. With the cabriolet a maximum speed of 25 miles per hour can be obtained. The control lever also operates a 10-in. contracting band brake on the propeller shaft. The worm-bevel gear-axle construction is the same as that utilized on other Chicago electric cars.

The battery equipment consists of sixty G7-type cells in which the internal resistance is reduced approximately 50 per cent, it is claimed, in addition to affording higher capacity without taking up additional room. The new battery is also considerably less affected by temperature changes, it is claimed, than other batteries. When lead batteries are used. the equipment consists of 40 Exide cells.

Steel Reflectors

Steel reflectors, designated by the Manufacturer, Harvey Hubbell, Inc., Bridgeport, Conn., as focusing, dis-

FIG. 1—FOCUSING TYPE STEEL REFLECTOR

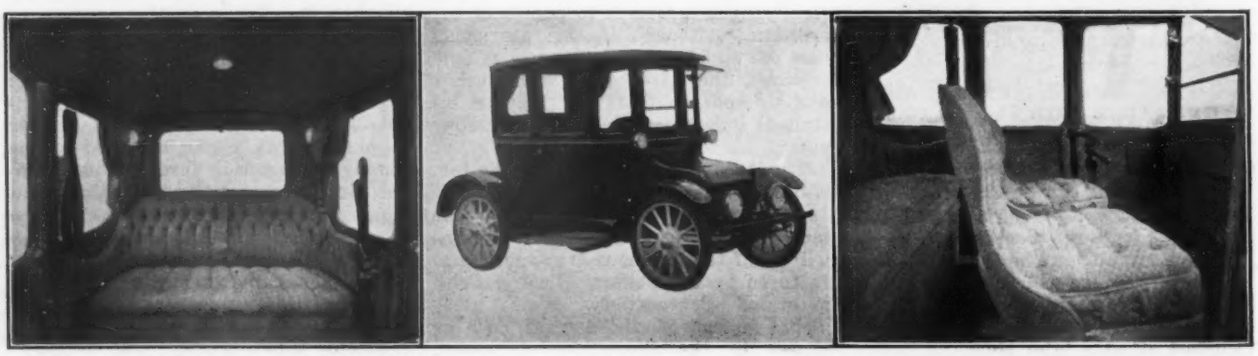
tributing and intensive types, are shown in Figs. 1, 2 and 3, respectively. To present a comprehensive means of identification, the manufacturer has also established a series of letters and figures in combination which designate the type of holder, the finish, the function of the reflector and the rating of the lamp best adapted for use with the reflector. For instance, the focusing type of reflector is designated as an HAF-60 device, H designating the standard Hubbell contractile collar holder, A the aluminum inside finish, F the focusing distribution of light and 60 the rating of the lamp in watts with which the reflector produces the maximum efficiency. In like manner the

FIG. 2—DISTRIBUTING TYPE REFLECTOR

distributing type reflector is designated as an HAB-100 device and the intensive type as an HAI-100 device. The intensive type reflectors are primarily designed for lighting large areas, though they may be also utilized to advantage, it is pointed out, in illuminating a group of machines by centrally suspending them from drop cords, thus reducing the dis-

FIG. 3—INTENSIVE TYPE REFLECTOR

tance between the units and the floor intensifying the light within the required area. The focusing-type reflector is adapted for localized illumination of high intensity over a small area. The smaller units are particularly adapted for bench work where small articles are assembled or where vises are used. The distributing-type reflector, as its name implies, is intended for general illumination in factories or warehouses. All of the reflectors are equipped with standard Hubbell contractile collar holders, making the use of a separate shadeholder unnecessary. The reflectors are of sturdy, uniformly spun steel, finished green outside and aluminum inside. Various types are available for use with lamps ranging in rating from 10 watts to 100 watts.



FIGS. 2, 3 AND 4—INTERIOR AND EXTERIOR VIEWS OF REAR-DRIVE CAR AND INTERIOR VIEW OF FRONT-DRIVE CAR

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Standardization of Retail Prices

Topics Before Convention of Ontario Electrical Dealers and Contractors at Toronto—Practical Co-operation at Brantford, Ont.

At the second annual convention of the Electrical Dealers & Contractors Association of Ontario, held at Toronto on June 6, 7 and 8, the total registration of 175 included representatives from all parts of the province. In addition, a number of visitors from Quebec came up to inspect the electrical show which was a feature of the contractors' convention. The exhibits included many displays of electrical appliances by prominent Canadian and United States manufacturers.

Following the address of welcome by G. D. Earle on Tuesday, H. F. Strickland, chief electrical inspector of the Province of Ontario, spoke on provincial inspection topics. During the discussion on electrical construction methods, Mr. Strickland mentioned the fact that the introduction of the electric range has been a factor in the change made in abolishing 0.5-in. surface pipes. By making 0.75-in. pipes the minimum, he said, it is found very much easier to take out the existing wire and replace it with larger conductor, than to tear out and change the pipe itself later when an electric range is to be installed.

MERCHANDISING AND RESALE PRICES

On Wednesday morning J. C. Kirkwood delivered an address on "Advertising," and Gordon C. Keith, in a paper entitled "How to Keep the Electrical Business in the Family," described methods by which the electrical contractor and dealer may make a merchant of himself and reap fuller profits from the business made possible by the great development in electricity.

Several speakers took part in the discussion of the subject of resale which followed. C. A. McLean of the Masco Company, who spoke as a jobber, declared that standardized prices would give dealers a feeling of confidence, particularly in the field of household articles. In the resale of contractors' materials, he suggested that a standard percentage above cost might be arrived at. Edward G. Weeds of the Canadian National Carbon Company pointed out that prices must be kept as low as possible in order to encourage sales. He urged that price cutting of advertised goods be stopped, and that standardized prices would make satisfied customers.

CONTRACTOR AND CENTRAL STATION

Several speakers dealt with the subject of co-operation at the Wednesday session. Walter Carr opened the discussion by pointing out how easy it would be to reach an objective point if all the members could be made to "pull together." F. M. Dusebury, Hughes Electric Heating Company, emphasized the benefits of co-operation and declared that contractors are the legitimate dealers in electrical goods. Too often, he pointed out, the contractor's chief competitor is the local central sation, although in many sections central stations and contractors are now getting together. Such co-operation, he declared, should exist in every town. But if the central station is to go out of the retail business, the contractors and dealers, on the other hand, must in turn be active in getting after this business. In closing, Mr. Dusenberry emphasized the importance of the subject of retail prices and urged manufacturers to get together to deal with questions of cost, overhead charges, freight and other problems. A. H. W. Joyner insisted that the only satisfactory way to enter into co-operation is to do it unselfishly for the success of the business. Through giving service, he declared, the contractor and dealer will benefit from the results of that service.

PRESIDENT-ELECT G. D. EARLE

THE BRANTFORD PLAN OF CO-OPERATION

R. T. Jeffrey of the Ontario Hydroelectric Power Commission pointed out that the more customers the central station has the more business will there be for the electrical contractor. If the contractor charges too much for his work, declared Mr. Jeffrey, the central station is prevented from getting business. On the other hand, in some municipalities there are so-called contractors who do work so cheaply that a reputable contractor will not go into these communities because he cannot make a living. There is a happy medium, however, declared Mr. Jeffrey, which the contractor should observe in steering his course. The Brantford (Ont.) Electrical Club, which he cited, has in active operation a plan by which electrical manufacturers and contractors are co-operating to arrive at fixed reasonable charges for contracting work. Such an electrical club, said Mr. Jeffrey, can fix prices for standard wiring very accurately, even though it may not be able to settle costs in advance for special wiring. There are hundreds of homes which are not yet wired because the owner has gone to one contractor and received, for example, a price of $60, and to a second and received a price of $42—after which, coming to the conclusion that graft exists somewhere, his wiring is not done at all. The rates fixed for wiring work should be agreeable to both the central station and the contractor, suggested the speaker. For example, the names of contractors working under the approved prices could, he proposed, be added on the cards used by the central station salesmen in soliciting business.

E. F. Griffith spoke of the necessity of proper accounting for contractors and dealers. T. M. DeBlois pre-

sented a paper on the necessity for satisfying the eye in planning lighting systems.

Acting upon the report of the committee on organization, the Ontario association will hereafter be conducted independently of the Retail Merchants organization, but electrical contractors' clubs will be organized in the future in all counties of the province. Any electrical man may become a member, but the officers of the association must be dealers or contractors.

Following are the officers elected for the year: President, G. D. Earle, Toronto; first vice-president, J. N. Miller, Peterboro; second vice-president, W. J. McLinden, Owen Sound; secretary, E. A. Drury, Toronto; treasurer, M. S. Soules, Oshawa; chairman licensing committee, W. H. Lodge, Toronto; chairman electrical development committee, E. Etherington, Stratford; chairman committee on resale, George T. Dale, Toronto; chairman committee on inspection, W. R. Fellows, Jr., Blenheim; chairman committee on organization, A. C. Lyons, Brantford.

G. D. Earle, the president of the Electrical Dealers & Contractors' Association of Ontario, is a native of Peterboro, where he started into electrical work. For about ten years he was employed by the Canadian Pacific Railroad as a traveling electrical man. Five years ago he came to Toronto and for the past two years he has been carrying on a large contracting business with offices at 72 Nelson Street. Mr. Earle organized the convention and for this work was elected president.

Amendments to Patent Law

Two bills before Congress designed to amend certain sections of the patent law have been passed by the House of Representatives and are now pending in the Senate. These bills would amend Secs. 4894 and 4931 to read as follows:

"Sec. 4894. All applications for patents shall be completed and prepared for examination within one year after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same within one year after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the commissioner of patents that such delay was unavoidable.

"Provided, however, that no application shall be regarded as abandoned which has become the property of the government of the United States, and with respect to which the head of any department of the government shall have certified to the commissioner of patents, within a period of three years, that the invention disclosed therein is important to the armament or defense of the United States.

"Sec. 4931. Patents for designs may be granted for the term of three years and six months, or for seven years, or for fourteen years, as the applicant may in his application elect, and that during the term of letters patent for a design heretofore or hereafter issued for one of the shorter terms, the owner thereof may at any time, but not later than thirty days prior to the expiration of the term for which said patent was issued, file with the commissioner of patents his election of one of the longer terms provided for by law, said application being accompanied by an amount of money equal to the difference between the fee paid for the patent as issued and the fee that would have been required to be paid had the applicant for said patent originally elected such longer term plus 20 per cent. The commissioner of patents shall thereupon amend and modify the letters patent issued in such case so as to include the unexpired balance of such longer term so elected by the owner of said letters patent."

$3,750,000 for Chicago Street Lighting

Incandescent Lamps of 600-cp. and 100-cp. with Substation and Generating Units Provided to Augment Present Equipment

A bond issue of $3,750,000 has been authorized by Chicago's City Council and passed by a referendum vote, as was noted in last week's issue of the ELECTRICAL WORLD. The funds derived from the sale of these bonds will be expended to install more than 30,000 incandescent lamps, three new substations, additions to five existing substations and one new generating station.

The lighting equipment to be installed will be of two general types, one using 100-cp. incandescent lamps and the other one using 600-cp. incandescent lamps. Distribution will be by underground series circuits of armored cable laid in the parkway next to the curb 18 in. below the ground level. A multiple-series transformer at each lamp will practically eliminate the danger attendant on the use of high-tension circuits. Where these lamps are used two lamps will be installed on diagonal corners at each street intersection, one at each intersection of a street with an alley, and an additional number of lamps so spaced that there will be one lamp for each 75 ft. of street.

Except where poles are already in place the 600-cp. series lamps will be supported by tubular steel poles extending approximately 25 ft. above the ground level and with the lamps suspended at an elevation of 22 ft. There will be in service one 600-cp. lamp at each street intersection and at each street and alley intersection, and sufficient additional intermediate lamps.

The estimated cost of the different parts of the proposed system is as follows:

Location	Equipment	Cost
Emerald Avenue district	329 600-cp. lamps, poles, wire and additional substation equipment	$24,500
Wentworth Avenue district	1202 600-cp. lamps, poles, wire and additional substation equipment	108,800
Wood Street district	355 600-cp. lamps, poles, wire and additional substation equipment	29,400
Wabansia Avenue district	Sixty 600-cp. lamps, 1185 100-cp. lamps, poles, wire, feeder cable and additional substation equipment	144,200
Northwest substation district	344 600-cp. lamps, 7954 100-cp. lamps, poles, wire, feeder cable substation to feed above lamps	915,600
R. A. Waller substation district	362 600-cp. lamps, 6687 100-cp. lamps, poles, wire, etc.	595,300
	Conduit, feeder cable and additional substation equipment	38,600
South Chicago substation district	1641 600-cp. lamps, 3026 100-cp. lamps, wire, poles, etc.	615,200
Southwest substation district	917 600-cp. lamps, 6058 100-cp. lamps, poles, wire, etc.	836,000
	Two substations to feed above two districts	96,000
	Transmission cables to feed above two substations	74,500
Other miscellaneous districts	300 lamps with poles, wires, etc.	30,200
Ninety-fifth Street incinerator plant	2000-kw. generating equipment	150,000
Total expenditure		$3,750,000

Most of the 600-cp. lamps will be installed in the territory between Twelfth Street and Fifty-fifth Street and in South Chicago for the reason that this district is at present in a large part lighted with 600-cp. lamps at street intersections. The new lamps will be added to present circuits or will be made into new circuits containing some old and some new lamps. For South Chicago the 600-cp. lamps are planned because this territory is largely devoted to business, has many street car lines and few trees, and trolley poles can be

used to advantage on many streets for supporting wires and lamps. The installation of the 100-cp. lighting system would be extremely expensive, on account of lack of parkways. The territories in which it is proposed to install the city's 100-cp. lighting system are in general residential, have many trees, are lighted by gas and gasoline lamps, or are not lighted at all at present. The business streets of these districts, however, will have 600-cp. lamps.

This extension will increase the connected load by about 4000 kw., and since the Sanitary District of Chicago is unable to furnish any additional energy to the city it will be necessary to secure some other source of power. The item of $150,000 covers the installation of a generating station in connection with the Ninety-fifth Street incinerator plant, now being built by the Department of Health. Boilers are now being installed by the health department and unless some use is provided for the steam thus incidentally produced the energy would be wasted. It is proposed that the electrical equipment be installed out of the proceeds of this bond issue, and that the Department of Health be put in charge of the operation of all the steam and electric generating equipment, and that the Department of Gas and Electricity buy from the Department of Health the energy delivered to the street lighting system at the rate now paid to the Sanitary District.

The amount of energy to be developed at the Ninety-fifth Street incinerator plant will be approximately 2000 kw., leasing 2000 kw. to be supplied from some other source. The Department of Public Works contemplates the installation of a generating station to supply lighting and power to the municipal building group at Thirty-first Street and Sacramento Avenue, and since all but a small part of this energy will be used in the daytime prior to 4.30 p. m. it is understood that upon the completion of this plant, estimated as Nov. 1, 1916, the Department of Public Works will be able to supply the street lighting system with approximately 1000 kw. after 4.30 p. m. Inasmuch as the entire installation of the street-lighting system covered by this proposed bond issue would probably not be completed inside of three years, additional capacity may then be installed at a later date to take care of the remaining 1000 kw. required under these plans.

Lighting Features of Technology Dedication

The spectacular masque and pageant given in connection with the dedication of the new plant of the Massachusetts Institute of Technology, Cambridge, Mass., on June 12 and 13, involved some remarkable lighting features. About 500 persons took part in the drama, which portrayed the progress of man from barbarism up to the present day.

Flood-lighting and spotlight effects were produced by means of thirty-four 1000-watt stereopticon projectors containing nitrogen-filled lamps installed at 3 ft. 3 in. intervals on the roof of the building on the east side of the court, and a similar number on the west building, in both instances about 55 ft. above the level of the court. Twelve projectors in each group were equipped with blue, nine with red and nine with green Pevear color screens, and by a skillful combination of colors any tint ranging from white was obtainable.

The central ring, occupied by the performers, had below its floor level four 1000-watt projectors, each in a pit with glass cover. These were for lighting effects connected with the dancing, and there were besides four 250-watt units, also in glass-covered pits, which illuminated jets of water in connection with the water dances.

From the administration building, fronting the court, six 500-watt projectors, without screens, were used for spotlighting, and on the roof two 60-amp. direct-current searchlights, loaned by the United States Navy, picked out the various craft in the river in front of the new buildings. A telephone system connected each group of lamps with a central operating booth in the court, from which the pageant director gave his orders. An attendant at each station repeated the orders to the dimmer operators as they were received by telephone.

The yard lighting served as an auxiliary to the feature lighting. The permanent installation consists of hexagonal lanterns ranged along the buildings, each containing a 200-watt tungsten lamp so shaded as to throw the light on the building façades. These lamps were kept burning while the audience was being seated, after which they and all interior lights in the building were extinguished.

Public Service Commission News

Idaho Commission

The right of the Public Utilities Commission to require a municipality to secure from the commission a certificate of public convenience and necessity before the municipality can vote bonds and proceed to install electric power or water plants is the important issue involved in the case now before the Supreme Court. It was raised by A. Cook, a resident of Coeur d'Alene, who applied for a writ of prohibition to be directed against the Mayor and City Council of that city to prohibit them from proceeding with the floating of a $280,000 bond issue, the proceeds from which are to be used to install such plants. Mr. Cook sets forth that the city has not secured a certificate from the commission to go ahead, and that therefore it cannot proceed. He further sets forth that the Consumers' Company, a corporation, secured franchises from the city of Coeur d'Alene to install electric and water plants there, and is now operating; that the city seeks to duplicate the plants, causing waste and dissipation of the people's funds, while it has gone beyond the law by exceeding the 6 per cent maximum of the total assessed valuation in a bond issue. The assessed valuation of the city for 1915 was $2,969,797, so that the total bond issue that could be floated on this valuation would be but $176,187.62, while the city has declared for a $280,000 issue.

Missouri Commission

Where it is shown that the cost of serving minimum resident consumers of electricity amounts to more than the minimum charge the minimum monthly bill is considered reasonable and is permissible, it was held by the Public Service Commission in its decision regarding the complaint against the minimum meter charge of the St. Joseph Railway, Light, Heat & Power Company. All discrimination is not prohibited, it was pointed out by the commission, but only such discrimination as is unjust or unreasonable or gives an undue preference or advantage or an unreasonable prejudice or disadvantage. The law does not prevent the reasonable classification of electricity consumers, but permits placing in each of several classes all the consumers who are served alike and contemporaneously and under the same or substantially similar circumstances and conditions, and there is no unjust discrimination in classifying consumers and serving them under classified schedules of rates with sliding scales based more or less on the average cost of service to consumers in each class. Serving power consumers of electricity under regular schedules in lieu of special agreements was held to be in accordance with the provisions of the public service commission law, particularly as affects equitable rates.

New Plant For Kansas City.—It is learned that the Kansas City Light & Power Company will within eighteen months have its own power station to cost about $2,500,000. The location has not yet been selected.

Second New Power House for Great Western Power.—The Great Western Power Company is contemplating the construction of a second power house on the Feather River, the corporation recently announced.

Electrical Contractors Increase Prices Because of New Code.—Real estate men and builders of Toledo, Ohio, have been notified by electrical contractors that, beginning June 1, the cost of wiring houses will be increased 30 per cent. They claim this is necessary because of the requirements of a new electrical code which went into effect at that time. Councilmen claim that the code is the same as is used in every other large city in the State.

American Gas Centenary.—In commemoration of the centenary of gas production in America, the Consolidated Gas, Electric Light & Power Company of Baltimore has published a centennial number of the Baltimore Gas & Electric News. The first city in America to inaugurate a gas company was Baltimore on June 17, 1816. The present company is the direct descendant of the pioneer corporation, the Gas Light Corporation of Baltimore.

Plans for Municipal Ownership Fail in Illinois Town.—At the recent mass meeting held in Le Roy the proposition of taking over or installing an electric light plant did not meet with much approval. The plan submitted by the city for consideration was that the necessary money be procured by issuing public utility certificates, which would not be a lien against the city, but only against the electric light plant. It was proposed to distribute these certificates among the citizens of Le Roy. The law provides under this plan that the city would have the right to establish rates adequate to maintain this property, pay interest on these certificates, and create a sinking fund for retiring certificates at maturity.

New Building for Baltimore Company.—The Consolidated Gas, Electric Light & Power Company of Baltimore is now building a new twenty-story home in the heart of the city. About one-half of the building, which will have more than 180,000 sq. ft. of floor surface, will be utilized by the company. The entire basement and mezzanine, second and third floors will be used for the showrooms and retail shops of the company. In them every kind of gas and electric device, utilitarian and ornamental, will be exhibited. The upper floors, besides the customary offices, will be notable as marking the introduction of a feature entirely new to Baltimore, but which has been tested with great success elsewhere. On each of these stories there will be a retail shop surrounded by office corridors, constituting an ideal means for the display of specialties both gas and electric and the sale of merchandise.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

May Light Logan Monument in Chicago.—The statue of Gen. John A. Logan, which stands in Grant Park, facing Michigan Boulevard, Chicago, was flood-lighted temporarily during Chicago's Preparedness Parade. A movement is now on foot to make the lighting installation permanent.

Stevens Institute Fund Now $1,300,000.—President Humphreys of Stevens Institute of Technology announced at the forty-fourth annual commencement in Hoboken that of the $1,385,000 subscribed to the Stevens fund more than $1,300,000 has been collected. The fourth payment is not due until Sept. 1.

Maryland Electric Utilities.—There are forty-one electric light utilities in Maryland with a capital stock of $11,553,874; funded debt of $14,165,700, making a total capitalization of $25,719,574. The interest accrued on the funded debt amounts to $677,598, and dividends declared amount to $715,226. There are also five combination gas and electric properties capitalized at $47,526,053, $15,917,550 of which is stock and the remainder funded debt. Interest amounts to $1,352,150 and dividends to $1,075,014.

Poker Explodes.—A steam plant had occasion to use as a poker a 10 ft. rod made of heavy tubing, one end of which had been hammered together, the other end being open. The open end was always thrust back into the coal pile after using with the result that some finely powdered coal found its way inside. It was decided, however, to close the other end also. The next time the poker was used to any extent there was a terrific explosion that tore the poker apart and hurled the fireman against the boiler. It was thought that a quantity of the powdered coal remained in the tube.

Kentucky Compensation Law Constitutional.—Having been held constitutional by the Court of Appeals of Kentucky, the Workmen's Compensation law enacted by the last Legislature of that State will go into effect on Aug. 1. All the central station companies and electrical contractors will be affected, since the law applies to employers of five or more and is virtually compulsory, depriving those who do not accept its terms of various common law defenses. No State fund is provided for and insurance may be carried with commercial or mutual companies or by the employers themselves who satisfy the Compensation Commission of their ability to do so. All the provisions of the law except one relating to indemnities payable to non-resident alien beneficiaries of persons insured have been passed on.

Lamp Works Sends Illuminating Engineers to Toledo.—The Toledo (Ohio) Railways & Light Company has been able to introduce a service to manufacturers and merchants by having four of the illuminating engineers of the National Lamp Works of Cleveland visit Toledo for two weeks to give expert advice on lighting. On request they will visit any factory or store and devise plans for improving the lighting system. No charge will be made for this service. It is merely a plan to improve the lighting wherever this is desired.

Taxes Levied on Property Used Exclusively by Utility Held Illegal.—The city of Harrisburg cannot legally collect a property tax of $56.05 from the York Haven Water & Power Company, a tax on the company's Nineteenth Street substation. The York Haven Company has no franchise to do business in Harrisburg, it is said, and it got into the city without one because the plant was erected on Nineteenth Street before that section of the city was annexed. The Supreme Court has decided that a municipality cannot collect a tax from a public service company when the tax is levied on property that is used exclusively by the company.

Commonwealth Edison Buys Land for Future Development.—The Commonwealth Edison Company of Chicago has purchased 50.32 acres of land in the southwestern part of the city fronting on Hamlin Avenue and South Fortieth Avenue and extending from Thirty-third Street south to Thirty-fifth Street at a price of around $132,000. The land was purchased for future development, and the company expects, at such time as the rapidly increasing demand in the central west section of the city makes it advisable, to build on it a power house of several hundred thousand horsepower rating. This step, however, is still several years in the future. The purchase of the property is in line with the company's general policy to secure real estate as far in advance of the time when it will be needed as is practicable.

To Facilitate Extension of Rural Service in Oklahoma.—Recommendation that two laws affecting public service corporations be passed at the next session of the State Legislature was made by the Oklahoma Gas, Electric & Street Railway Association at its recent convention. An attempt will be made to secure a law to facilitate extension of light and power lines into country districts for the benefit of farmers by giving the companies right of eminent domain along public highways outside corporate limits. This right is now enjoyed by telephone companies. A bill such as the association wants was vetoed by Governor Williams at the last regular legislative session because it was improperly drawn. The other legislation recommended is intended to eliminate wasteful duplication of public utilities by empowering the corporation commission to issue certificates of public convenience and necessity before a new corporation can operate. The bill has the indorsement of the public service commission.

18,900-Kva., Single-Phase Generator for Norway Hydroelectric Plant.—An 18,900-kva., single-phase generator has been built by the Swedish General Electric Company for the second Rjukan power station at Saaheim, Norway. The machine complete weighs 200 tons, of which about 90 tons are in the stator and 80 tons in the rotor and shaft.

Guy Wires Must Be Insulated to Height of 8 Ft.—As an additional safeguard to the public the Portland (Ore.) Council has recently passed an ordinance requiring the insulation of all guy wires and cables leading from electric light or telephone wires or cables, to a height of 8 ft. horizontally above the ground. A previous ordinance required insulation to a height of 6 ft., but the measure did not state that the 6 ft. shall be horizontal and therefore many wires running at an angle were insulated only a few feet above the ground.

Increase of 37 Per Cent in Electrical Manufacturing Profits.—A table of industrial profits available for dividends made by Rudolph Diamant for the *Commercial & Financial Chronicle* shows that six manufacturers of electrical supplies with a total capitalization of $280,617,275, had available for dividends $25,377,370 or 10.26 per cent of stock capitalization for the year 1915. The net profits available for dividends in the previous year amounted to $18,747,249 or 8.08 per cent on the stock. The increase in profits of 1915 over 1914 was $6,630,121 or 35.37 per cent.

Indiana Soldiers' and Sailors' Monument to Be Flood-Lighted.—The famous Soldiers' and Sailors' Monument in the Circle in Indianapolis is to be flood-lighted by the Indianapolis Light & Heat Company. The lighting is to be a contribution from this company to the State of Indiana, in commemoration of the one hundredth anniversary of the State's birth, and the lights are to be placed and operated at no expense to the State or the commission, which controls the monument. The monument was erected at a cost of $600,000. From the street level to the top of the statue is 284.5 ft. The statue on the top is 34 ft. high.

Fireproofing Prevents Cable Trouble.—Fireproofing between the sections of a large conduit of the Kansas City Light & Power Company recently saved the service from serious disarrangement when a short-circuit damaged cables. The short occurred within a few feet of the substation at Fifteenth Street and Grand Avenue and sixteen of the feeder circuits, direct current, leading from the substation, were damaged. The heavy voltage circuits entering the substation, in ducts below those where damage occurred, were not affected, and sufficient other circuits were protected to maintain service out of the substation. The short-circuit and the burning of gases in the conduit formed so hot a fire that metals were fused, and the sand dumped in to smother the fire was blown several feet in the air by the blast upward out of the manhole. The sand was finally effective.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Los Angeles Jovian League.—At the meeting of the Los Angeles Jovian Electric League, June 7, Superior Judge Paul J. McCormick gave a stirring address on "Sparks at Random on the Subject of Patriotism."

Dallas Electric Club.—A. B. Elias, general superintendent of the plant of the Southwestern Telegraph & Telephone Company, spoke at the meeting of the Dallas Electric Club—Jovian League—on June 9 on the subject of "Safety First."

Louisiana Engineering Society.—A regular meeting of the Louisiana Engineering Society was held on June 12. J. W. Fairlie, veteran of the battle of Ypres, told of his personal experiences in the trenches on the battlefields of Europe.

Minnesota Section, A. I. E. E.—At the last meeting of the 1915-1916 session held at the St. Paul Athletic Club, K. Hershey of the Tri-State Telephone & Telegraph Company, gave a demonstration and address after which the main exchange of the telephone company was visited.

New York Electrical Society.—The annual meeting of the New York Electrical Society was held at the Hotel McAlpin on June 14. A paper on "Preliminary Notes on a New Way of Converting Light Into Electrical Energy," by Theodore W. Case, was presented. The following officers for the new year were unanimously elected: President, Putnam A. Bates; vice-presidents, C. E. Scribner, Edwin B. Kalte and W. C. Whiston; secretary, George H. Guy; treasurer, Thomas F. Honahan. The society now has a membership of more than 700.

Tri-State Water & Light Association.—The sixth annual convention of the Tri-State Water & Light Association of the Carolinas and Georgia will be held at the Isle of Palms, S. C., on June 21, 22 and 23, and the indications are that the sessions will be largely attended. W. F. Stieglitz of Columbia, secretary-treasurer of the organization, has completed all arrangements for the meeting. Among the speakers are R. E. Milligan of New York; Mayor T. T. Hyde and P. H. Gadsden, Charleston; Vann Livingston, Atlanta; A. A. Passolt, Newman; W. M. Gallant, Charlotte; J. W. Neave, Salisbury; F. C. Wyse, Columbia; A. J. Stroples, Greenwood; J. G. Barnwell, city manager of Rock Hill.

Radio Club of America.—A meeting of the Radio Club of America was held on June 9 at Columbia University, New York City. Paul F. Godley presented a paper on "Applications of the Audion," in which were discussed important considerations in design, construction and operation of apparatus used with the audion as a detector for short or long wave reception, as an amplifier, and as a generator of high frequency oscillations to be used both in the reception of undamped waves, and as a source of power for radiotelegraphic and radiotelephonic transmission. Complete diagrams, data and specifications were given.

Pittsburgh Section I. & S. E. E.—The monthly meeting of the Pittsburgh section of the Association of Iron & Steel Engineers will be held at Fort Pitt Hotel, Pittsburgh, Pa., on June 17. A directors' meeting will be held in the afternoon, and the evening will be given over to papers and discussions. This meeting will be held under the auspices of the educational committee of the association, C. A. Menk, chairman. Outlines of educational work, as carried on by their firms, will be given by M. W. Alexander, General Electric Company, C. R. Dooley, Westinghouse Electric & Manufacturing Company, and several of our members. This will be the last monthly meeting of the Pittsburgh section prior to the annual convention, which will be held at the Hotel La Salle, Chicago, Ill., on Sept. 18-22.

Cleveland Electrical League.—George B. Post & Sons are preparing plans for the clubrooms of the Cleveland Electrical League to be built on the roof of the Hotel Statler, and the hotel company has taken out a permit for the construction work. The rooms will be ready for occupancy this fall. The Cleveland Baseball Club has reserved the entire covered pavillion, containing 6000 seats, for the members and guests of the league for the initial game between the New York Americans and the Indians, scheduled for June 15. In order to dispose of these seats at the rate of $1 each, twelve teams composed of a captain and nine men each have been organized and the members were called upon to aid in the work. A daily individual score tally of sales will be kept and the member holding the highest score will be awarded a gold watch, and the next highest will receive a gold watch fob. The highest scoring team will be tendered a banquet. At its annual meeting on June 8 the league elected the following officers: President, N. H. Boynton; directors for two years, Norman Anderson, J. M. Bateman, M. G. Buchan, H. J. Davis, F. R. Du Guay, H. O. Leinard, George S. Milner and H. L. Schneider. The following directors, elected last year, will hold over for this year: H. B. Dates, H. S. Greene, J. T. Kermode, Mathias E. Turner and H. C. Turnock. The league now has a total of 1225 members.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

European and American Competition in Export Trade

What Conditions American Electrical Manufacturers Must Face in Developing Foreign Trade

BY H. S. FOLEY

If American manufacturers wish to develop their export business and supply foreign countries with American material they must decide to supply American engineers coincidentally to sell their output and to teach consumers in foreign countries how to use it.

One could name German and English houses in half a dozen foreign cities that are agents for American manufacturers, but the case is rare where the infrequent American house acts as agent for German goods. These foreign houses carry no stock of American machines and in reality simply take the agency to block the appointment of a bona-fide manufacturer's representative; and as they turn in little business the manufacturer never really considers the appointment of a special representative. They also appropriate the benefits of the advertising of their American principals by diverting such inquiries as come to them to their European houses. An operating engineer in Europe, writing to an advertiser in the ELECTRICAL WORLD, received a letter in reply stating that a London concern was the representative for that territory and that the inquiry had been forwarded to it. In due course a letter came from the London house offering an English machine made in Liverpool.

Latin countries especially have used an immense proportion of the output of German factories, so that the people have been accustomed to the appearance of this material and the workmen have been educated by German foremen to install it along German lines and are unfamiliar with the American way of working. Spanish workmen, for instance, insisted on filling American conduit with sand and heating it before bending, and one man nearly tore an American lamp socket to pieces in trying to unscrew the cap until he was shown that by a simple "press here" it could be dismantled very easily.

Among German manufacturers it is a cardinal principle that as much work as possible shall be done in the factories of that country; nothing is built on the job that might be done in the factory. Thus all material is sent out as nearly finished as possible and fitted for erection with unskilled labor. A few examples will illustrate this. Duct lines are never built under German administration, but armored cables are sent out requiring only to be laid in a trench and covered over. A remote control installation is made with multiple conductor cable instead of iron conduit with the wires drawn in. Switchboards are sent out consisting of a steel panel with oil switch and instruments mounted thereon and with instruments completely wired up, requiring only to be connected into the high-tension circuit. These instances might be multiplied indefinitely. This policy might be called the keynote of German organization.

It should not be inferred that the object is to save money for the operating company; there is usually an excess of personnel in the foreign company, but most of it is unskilled or only partially trained. The German engineer does not attempt to make a thorough mechanic of the native as does the American, but encourages inefficient methods if they mean that factory-made supplies will be required. Thus cable is usually used as small as No. 10 and 12 B. & S. gage wire. Workmen protest when asked to use solid wire. Bergmann tube, a paper-thin brass tube lined with paper, and Kuhlo wire, two or three wires, rubber insulated and metal sheathed, are universally used for house wiring. Any ordinary laborer can install them after a few lessons in the use of the specially-made bending tools.

Labor is considered cheap in other countries than America and the use of a machine which will displace a man does not find favor. It appeals still less if it only saves time which might be utilized in other work. It is only when many men may be displaced that such a machine is considered worth while. Apparatus requiring a great deal of supervision and frequent cleaning and adjustment is not unpopular unless requiring a shut-down for the purpose.

The German system of rating places the American manufacturer at a disadvantage in dealing with a customer unfamiliar with American practice. This customer, comparing prices on American and German motors, does not know that while the latter will pull its rated load under test conditions, the former will pull the rating given on the nameplate between wide limits, with some power to spare for occasional overloads. Another consideration is the fact that he can usually buy the European motor from stock. A European who wanted to know why he should buy a motor with such a generous rating as is given by American standards was asked the counter-question as to whether he would consider building a bridge without a factor of safety. As it is usual to equip a machine with a motor rated at the maximum demand of the machine, it is not usual for motors to burn out, but power factors are generally low.

There is commonly a slavish acceptance of the rule to install 1 kw. of transformer capacity per horsepower for motors, and as factories having 20 kw. or more are provided with a transformer station the transformers are rarely up to load, and then for but a short period.

A motor field which has once been won by American machines is not usually lost; many mining companies in Mexico, for instance, do not even ask for bids from German houses for the installation of motors.

The German unit of illumination, known as the Heffner only in English and German, and commonly called the candle-power in Latin countries, is also designed to create a favorable impression upon a buyer who compares the data furnished by German and American manufacturers. He sees that the former is apparently more efficient in watts per candle-power and therefore does not investigate further.

Keyless sockets are in general use in conjunction with a snap switch. In such a socket a small piece of porcelain forms the foundation. Two screws fasten the threaded thimble and also a small connecting piece with a screw for one lead. Another screw fastens a small piece of brass which forms the center contact and also carries a screw for the other lead. The shell and cap are two pieces of brass as thin as paper, which are fastened together by means of a pressed thread. A porcelain bushing with a thread on the inside screws on to the thimble and serves to insulate this from the shell. There is no paper insulation between the shell and the energy-carrying parts as in the American socket. Apart from the fact that it would not be passed by American underwriters, such a socket would be absolutely unsuitable in the United States on account of its lack of mechanical strength and its propensity to come to pieces when a lamp is screwed in.

In Europe when a lamp is put into a socket it usually remains there until broken or burned out; it is not being removed to be replaced temporarily by a flatiron, toaster or other appliance.

Just for comparison, American sockets (keyless) and German were weighed and there were found to be about 12½ and 17½ respectively of each to the kilogram; five more of the German make, or an increase of 40 per cent. Thus one can import 40 per cent more sockets for the same outlay in duty. American sockets do not move very rapidly on the European market, as might be expected.

A 200-kva. 6000/220-volt transformer of American manufacture was found to weight (core and coils only) 1200 kg., while a German transformer of similar type, size and voltage weighed 900 kg., or 75 per cent as much as the American. The difference in duty is considerable.

Tariffs in European and most Latin-American countries are usually based on the weight of material.

In order to compete with European manufacturers on even terms Americans should place nameplates on their exported machinery corresponding to European standards and use special export catalogs. Otherwise they will have to enter upon a campaign of education so that foreigners will understand the true basis for a comparison of prices.

Heating Device Situation

Standard List Prices and Discounts to Go Into Effect on Oct. 15—Royalties Small

In another four months the license arrangement entered into between the General Electric Company and the Hoskins Manufacturing Company on the one hand and a number of heating device manufacturers on the other for the manufacture and sale of electric heating appliances under the Marsh patent will go into effect. October 15, 1916, is the date that has been named as the latest time at which non-licensed manufacturers can sell products using nickel-chromium wire for resistance element.

Not all manufacturers of heating devices have yet become licensed.

At the same time that the license arrangement goes into effect there will also go into effect a list price on every appliance using nickel-chromium as a resistance element. This list price, which will be higher in some instances and lower in others than the prevailing prices, will be subject to a discount which will be the same for all producers. It is understood that the list price on flatirons will be in the neighborhood of $3.50 to $3.75, and toasters around $3.75.

These prices and discounts, however, are probably to a certain extent dependent upon he manufacturer; that is, the list prices under the terms of the license are probably the minimum and the discounts the maximum. If such is the case, the chances are that no lower list price or greater discount on this list price will be permitted. This would insure a minimum net price beyond which producers would probably not go. On the other hand, it is likely that manufacturers may offer higher list prices and with them greater discounts, the presumption being that the prices would not go below a certain minimum. Of course, there is nothing to prevent manufacturers from offering greater list prices and lower discounts.

The advances in price will not be entirely a matter of royalties, for it is understood that the owners of the patent have been very liberal in this respect. It has been felt in many quarters that heating devices have for a long time been sold too cheaply, which in many instances gave negligible profits. Such a system of prices, as might be expected, merely produces cut-throat competition and is of no advantage to the customer. Goods of less expensive materials with a finish similar to higher-priced goods is the natural result. Prices will in all probability be placed either at the same list and discounts or at a list and discount that will insure a reasonable profit on sales.

To a large number of manufacturers it is thought that this offers an unexpected opportunity. These men have been producing and selling appliances so close to costs that a poor season and an increase in the price of materials would push them to the wall. It is obviously out of the question to change prices with every fluctuation in the raw material and labor market so that manufacturers will embrace the opportunity in placing their output on a more stable basis.

All of the nickel-chromium wire, it is understood, that will be used after Oct. 15 for electric heating must be purchased from a licensed manufacturer, of whom at present it is learned there are three. The understanding is that these wire manufacturers will be prohibited by the owners of the patent from selling nickel-chromium wire to anyone but those licensed under the patent.

Increasing Use of Electric Furnace

Within the past year the use of the electric furnace in steel and metal mills has grown rapidly. Because the electric furnace business is a new industry it is hardly possible to state whether business is normal or abnormal. In view, however, of the extent of the field for electric furnaces and in view of the small number of units now installed it is believed that even if the war stopped to-morrow and metal prices came tumbling down that business would not fall off. If anything, the volume of orders would continue to increase, for it is pointed out that the present high prices are preventing a certain amount of metal buying. At lower prices, however, orders will be readily given so that it is believed that some considerable time will elapse before the volume of metal buying will drop off to any appreciable extent. Railroads, industrial establishments and utilities will not be able to carry out any extensive construction plans at prevailing prices. What construction work is being done is almost without exception one that could no longer be put off. Before long, according to present indications, prices will fall off, not abruptly but appreciably nevertheless. This decrease it is expected will stimulate purchasing so that, although prices go down considerably, production will not be materially affected. Under such conditions the buying of electric furnaces naturally ought to continue.

The growing demand for electric furnaces has been the result primarily of their economy of operation, rather than quality of product. It is hard to convince those brought up with steel that electric furnaces produce a product superior to that produced by the means now employed. It is not so difficult, however, after showing them costs per 100 lb. of production to have them waive aside old prejudices. The electric steel furnace can turn out many times larger quantities of steel than can its competitor, the crucible method.

For copper, bronze, bearing mixtures and some of the brasses the electric furnace has found a large demand recently, it is said, because the price of crucibles has risen abnormally and it is therefore much cheaper now to melt with electricity. Considering all of the charges, and with energy at about 1 cent per kilowatt-hour this cost is said to be about 14 to 16 cents per hundredweight.

The cost of installing furnaces necessarily is influenced by the cost of iron and steel, electrical equipment, labor, etc., and naturally the advance in price of these materials has found expression in the increased cost of electric furnace installations.

Deliveries have been longer than usual owing to the rushed conditions of the factories where the parts are made and also owing to the freight congestion.

Credits and collections are uniformly good, although there is a tendency to hold back payments as long as possible by those carrying a large amount of business in which practically all of their capital is tied up. Some furnace people have overexpanded, it is thought, and are demanding a partial payment with the order so as to be able to carry on further business.

Export Situation

Higher prices for practically all goods manufactured in this country has been accountable to a certain extent for the increase in value of exports. The general advance in prices, however, is not confined to products of the United States nor to materials especially affected by war conditions. A compilation by the foreign trade department of the National City Bank of New York shows that a very large proportion of the articles imported into the United States, irrespective of places of production or of war conditions, are materially higher at the present time than those of a year ago or two years ago. The compilation includes import prices of a large number of articles drawn from all sections of the world and represents the price in the country from which exported to the United States and not the price on arrival in this country or when sold in our own markets. While the large advance in freight rates naturally suggests higher prices for the imported merchandise on entering the ports of the country, this compilation represents the prices at the place of production or exportation to the United States.

England, France and Italy continue to be the largest

importers of goods of American manufacture. During the week ended June 3, 1916, there was shipped from the Port of New York to England goods valued at $19,800,804, to France $12,024,937, and to Italy $4,335,953. The total exports for the week from this port amounted to $51,510,335 as compared with $21,507,153 and $14,013,164 for the first week in June, 1915 and 1914 respectively.

Exports from New York to South and Central America amounted to $4,946,702 during the week ended June 3 last compared with $3,281,694 during the first week in June, 1915, and $1,940,883 during the first week of June, 1914.

Exports of copper wire from the Port of New York during the week ended June 3 last amounted to $44,480 compared with none for the corresponding week in 1914. In electrical machinery the exports totaled $122,266 compared with $102,111 during the first week of June, 1914.

Manufacturing and Industrial

The Gleason-Tiebout Glass Company has moved its New York office and showrooms to 200 Fifth Avenue.

The Westinghouse Lamp Company has moved its executive offices from 1261 Broadway, New York, where they have been located the past two years, to 165 Broadway, New York.

J. S. Jacobson, Chicago manager of the Trumbull Electric Manufacturing Company, has resigned and after a month's rest will start in for himself in the manufacturers' agency business in Chicago.

Adams-Bagnall Company to Enlarge Plant.—Several lots on Platt Avenue, Cleveland, Ohio, have been purchased by the Adams-Bagnall Electric Company, to be used in the enlargement of the company's present plant.

W. P. Naser has been appointed manager of the Chicago office of the Trumbull Electric Manufacturing Company, 15 South Des Plaines Street. He was formerly in charge of the San Francisco office of the company.

The General Insulate Company, 1014 Atlantic Avenue, Brooklyn, N. Y., has appointed the Bailey-Drake Company, with offices in San Francisco, Los Angeles, Denver and Seattle, as its representative in the coast territory.

A. D. Fishel has been appointed sales manager of the Adams-Bagnall Electric Company, Cleveland, Ohio, to succeed T. H. Bibber, who recently resigned to become general sales manager of the Luminous Unit Company of St. Louis.

F. R. Blair, formerly secretary, treasurer and sales manager of the S.K.F. Ball Bearing Company, has resigned and has become president of F. R. Blair & Co., 50 Church Street, New York. Mr. Blair will be engaged in the development of motor-driven efficiency devices.

The United Electric Construction Company.—In the ELECTRICAL WORLD of June 10, it was stated that the United Electric Construction Company of Philadelphia, Pa., which has recently established an office in New York, has a capital stock of $25,000. This figure is incorrect, the company being capitalized at $50,000.

E. L. Kent, who for several years has been railroad sales manager for the United States for the Pyrene Manufacturing Company, New York, has been elected vice-president of the Metal Hose & Tubing Company. Mr. Kent will be succeeded by William H. Yetman, who has been Western railroad representative for the Pyrene company.

Cleveland Plant of National Carbon Company Adopts Bonus System.—The 1400 employees of the National Carbon Company's plant at Cleveland, Ohio, have been notified that a bonus system has been made operative and that, in addition to the regular wages paid for both time and piece work, the men will receive $5 each at the end of each month and the women and girls $3. This depends upon continuous employment with the company.

No More Gas Fuel for Cleveland Industrial Companies After October.—The East Ohio Gas Company has notified all steam consumers in Cleveland that arrangements must be made for some other fuel by Oct. 1, when their gas supply will be turned off. No explanation was made for this step other than that the first duty of the gas company is to the domestic consumers. It is said that as many as 2000 shops of various kinds will be affected by this change.

New Western Electric Executive Offices.—The executive departments of the Western Electric Company at New York were recently moved from 463 West Street to new offices in the Telephone & Telegraph Building at 195 Broadway. The move was made necessary by the steady growth of the company's engineering departments, which will occupy the space that has been vacated. The local New York distributing department and the engineering and patent departments remain at 463 West Street.

Automobile Manufacturer Adopts Magnetic Gear Shift.—The "C-H" magnetic gear shift which is being placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has recently been adopted by the Premier Motor Car Corporation of Indianapolis, and will be part of the standard equipment of the company's new model cars. The magnetic gear shift mechanism, which has been described in these columns, does away with the hand gear-shift lever and permits the shifting of gears by means of push buttons.

K-W Ignition Company Carries Patent Case to Court of Appeals.—The record and transcript in the case of the K-W Ignition Company of Cleveland, Ohio, against the Temco Electric Motor Company, Leipsic, Ohio, was filed in the United States Court of Appeals at Cincinnati on June 9 from the United States District Court at Cleveland. The appeal is taken from the decree of Federal Judge Clark who held valid and infringed the Thompson patent covering improvements in spring suspension for automobiles and awarding an injunction and an accounting for profits and damages to the Temco Electric Motor Company.

Another Portland (Ore.) Apartment House Equipped for Electric Cooking.—The Hughes Electric Heating Company, Chicago, has just secured a contract for fifty-four ranges which will be installed in the Imperial Arms Apartment at Portland, Ore. The ranges sold are of two types, namely, forty-two of the C-4 type and twelve of the No. 50 type, the latter being placed in the higher-priced apartments and the plainer ranges being used for the others. These ranges will represent a connected load of 317 kw. This is to be one of the largest apartment houses in Portland to be equipped for electric cooking, taking service from the lines of the Portland Railway, Light & Power Company.

Westinghouse Men Gather in Atlanta for Sales Meeting.—Representatives of the sales department of the Westinghouse Electric & Manufacturing Company from the Southern territory gathered last week in Atlanta, Ga., for the annual sales meeting. The sessions began on Thursday and lasted the rest of the week. Meeting with these representatives were also representatives of the Westinghouse Air Brake Company and the Westinghouse Lamp Company of Atlanta. Business sessions and trades discussions were held Thursday and Friday. H. A. Cole of Atlanta, district manager for the Westinghouse Electric & Manufacturing Company, presided. The meeting closed Saturday with a chicken dinner and a dance at Cascade Springs.

NEW YORK METAL MARKET PRICES

	June 6 — Selling Prices Bid	Asked	June 13 — Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	124 0 0		121 0 0	
Prime Lake	28.00	to 28.50†	27.75	to 28.80
Electrolytic	28.25	to 28.75†	27.75	to 28.00
Casting	25.87½	to 26.12½†	25.50	to 25.75
Copper wire base	32.00	to 32.50†	31.00	to 31.50
Lead	7.00		7.00	
Nickel	45.00	to 50.00	45.00	to 50.00
Sheet zinc, f.o.b. smelter	21.00†		20.00†	
Spelter	13.55	to 13.80	13.42½	to 13.67½
Tin, straits	44.25		43.50	
Aluminum, 98 to 99 per cent	57.00	to 59.00†	58.00	to 60.00

OLD METALS

Heavy copper and wire	21.00 to 21.50†	20.50	to 21.00†
Brass, heavy	12.00 to 12.50†	12.00	to 12.50†
Brass, light	10.00 to 10.50†	10.00	to 10.25†
Lead, heavy	5.25 to 5.50†	5.37½	to 5.62½†
Zinc, new scrap	9.00 to 9.50†	10.00	to 11.00†

COPPER EXPORTS

Total tons to June 13 14,057

†Nominal.

Corporate and Financial

Binghamton Light, Heat & Power Co.—An offering of 6 per cent preferred stock was recently made at 94 and accrued dividend.

Middle West Utilities Company, Chicago, Ill.—In the annual report of the company for the year ended April 30, 1916, Samuel Insull, president, says in part: "For the first few months of this fiscal year there was a general depression in business all over the country. In fact, it was not until September, 1915, that any marked improvement in general business conditions was shown. In addition, the summer of 1915 was unusually cold and generally unseasonable, causing a marked falling off in the sale of ice and fuel gas, and in passenger receipts on street and interurban railways. At the end of August the gross income of the subsidiary companies was $107,275.95 lower for this fiscal year to that time than it had been in the previous fiscal year. To the general improvement in business which immediately followed, the earnings of the subsidiary operating companies responded remarkably well, with the result that their gross earnings for the whole fiscal year substantially increased over those of the previous fiscal year." The combined earnings of the various subsidiary operating properties during the company's fiscal year were as follows:

Gross earnings		$8,091,148
Operating expenses, including taxes		5,013,388
Net earnings from operation		$3,077,760
Rentals on leased properties		191,645
		$2,886,115
Bond, debenture and other interest charges paid or accruing to outside holders	$1,339,412	
Yearly amortization of discount on securities	24,642	
Dividends on stock and proportion of undistributed earnings to outside holders	206,093	
		1,570,147
Total earnings accruing to Middle West Utilities Company		$1,315,968
Of the above amount the Middle West Utilities Company received and accrued as interest on bonds and debentures	$503,070	
Received and accrued as interest and brokerage on money advanced	234,993	
Received and accrued as dividends on stocks	447,175	
		1,185,238
Middle West Utilities Company's proportion of the surplus carried to the aggregate surplus accounts of the subsidiary companies on their own books		$130,730

Narragansett Electric Lighting Company, Providence, R. I.—The company has purchased from Bodell & Company the controlling interest in the Westerly Light & Power Company, the latter firm having been in control of the Westerly property since 1912. The Narragansett company paid $95 a share for the stock and the same price is offered minority stockholders for a limited period. By the acquisition of the Westerly company Narragansett Lighting obtains control of the entire electric lighting and power situation south of Providence in Rhode Island and in southeastern Connecticut.

Nevada-California Electric Company, Denver, Col.—An issue of $3,943,500 of first lien 6 per cent bonds due on Jan. 1, 1946, is being offered at 98.5 and interest, yielding about 6.1 per cent. The proceeds will be used to provide for new extensions, additions and other corporate purposes.

Salem (Ohio) Lighting Company.—The Ohio Public Utilities Commission has given the company, a new corporation, authority to take over and consolidate the Salem Light, Heat & Power Company and the Columbiana Electric Company, competing concerns. In order that it may carry out this plan the new company was also given authority to issue $150,000 common stock and $150,000 first mortgage twenty-year 5 per cent bonds to be sold at a little above 93.

Santa Barbara (Cal.) Gas & Electric Company.—The California Railroad Commission has issued an order authorizing the company to issue $1,000,000 face value 5 per cent first mortgage bonds, at not less than 91, under a deed of trust to the Los Angeles Trust and Savings Bank. Of the bonds, $210,000 will mature serially at the rate of $10,000 a year, from 1920 to 1940. The remaining bonds will mature in 1941. From the proceeds of the sale, $884,625 is to be expended to retire the company's outstanding issue of $824,500 of bonds at 105, and $25,375 to reimburse the company for capital expenditures made from income.

Utah Securities Corporation, Salt Lake City, Utah.—The aggregate gross earnings of the operating subsidiaries increased 9 per cent and the net earnings 22 per cent during the year ended March 31, 1915, despite the unfavorable business conditions prevailing during the first three months of the twelve-month period. Of the year's total gross increase of $426,160 all but $81,720 was made in the last six months of the year, and of the year's total net increase of $482,135 all but $151,280 was made in the last six months of the twelve-month period. The copper and other mining industries in the districts served by the operating subsidiaries, which were much depressed during the first months of the European war, began to resume normal operations in April of last year, and from then on metal production was gradually increased. General business conditions in the territory served are now excellent, and it is believed that the earnings of the operating subsidiaries will continue to show a substantial growth. The most important addition to property during the year was in connection with the Utah Power & Light Company's Oneida plant on the Bear River, where a 10,000-kw. generator was placed in operation in September. An additional 10,000-kw. installation is now under construction at this plant and should be ready for operation within the next two months. Another installation of 7500 kw. is now under construction at Cove, near Grace, and will be completed in 1917. With these new units in operation the company expects to have sufficient plant capacity for some time to handle all of its business without operating its steam plant in Salt Lake City, except in emergencies. The operating companies increased the total number of electric and gas customers during the year from 47,762 to 53,397. The sale of electrical energy for miscellaneous power purposes was largely increased. A statement of the combined net income account of the Utah Securities Corporation and its subsidiary, the Utah Power & Light Company, including the subsidiaries of the latter, for the twelve months ended March 31, 1916, follows:

Gross earnings of Utah Securities Corporation, including surplus of subsidiary companies accruing to it		$1,258,029
Expenses, including taxes, of Utah Securities Corporation		208,911
Net earnings earnings of Utah Securities Corporation, including surplus of subsidiary companies accruing to it		$1,049,118
Profit on redemption of Utah Securities corporation ten-year 6 per cent gold notes retired during the year	$499,885	
Less commission	34,112	
		465,773
Income from all sources accruing to Utah Securities Corporation		$1,514,891
Deduct interest charges on ten-year 6 per cent gold notes		888,974
Combined net income		$625,917

The J. G. White Companies, New York, N. Y.—Chairman J. G. White in his annual report made the following statements in connection with the companies' operations during 1915: "Your companies during the past year have adhered strictly to their fixed policy of taking no large engineering or construction contracts except on a percentage or fixed fee basis. During the period under review there undoubtedly has been a considerable volume of rehabilitation and extension work in connection with the enlargement of industrial plants brought about by the abnormal condition due to the European war, but practically no new enterprise involving large work along the usual lines that your companies have been identified with in the past has been initiated, which has made it impossible for the companies to secure work of this nature. Your companies, however, have secured a considerable amount of purchasing for clients, which business has developed into a large volume during the past year due in great part to the prevailing conditions in the European markets, and it is believed that the connections that have been made may produce a very satisfactory volume of business in this line even after the close of hostilities in Europe. The officers of your companies believe that with the continued increase in the industrial development now going on in this country and South America, conditions along the lines of your companies' usual endeavor should improve during the year. However, it would seem that with the general unsettled political conditions throughout the world and uncertainties depending upon the outcome of the European conflict, it is very difficult to forecast the immediate future."

New Utility and Industrial Companies

The Humble Power & Ice Company of Humble, Tex., has been incorporated with a capital stock of $30,000 by F. A. Peters, C. L. Gossett and W. J. Peters.

The Petersville Electric Company of Beaver Falls, Pa., has been incorporated with a capital stock of $5,000. E. R. Baldinger of Pittsburgh, Pa., is treasurer.

The Sour Lake Ice, Light & Power Company of Sour Lake, Tex., has been granted a charter with a capital stock of $50,000. The incorporators are: F. H. Carpenter, A. H. Tarver and T. F. Cruise.

The Sanger Light & Power Company of Sanger, Tex., has been chartered with a capital stock of $10,000 for the purpose of constructing and operating an electric light plant in Sanger. The incorporators are: C. P. Dodson and others.

The Home Gas, Light & Power Company of Fairfield, Iowa, has been incorporated by Vernon L. Hague and others. The company is capitalized at $10,000 and proposes to generate and distribute electricity and gas for lamps, heaters and motors.

The Advance Specialty Company of New York, N. Y., has been incorporated with a capital stock of $10,000 to deal in electric novelties, devices and specialties. The incorporators are: I. Fertman, A. J. Pulsford and M. Weber, 761 East 156th Street, New York, N. Y.

The R. L. C. Specialty Company of Buffalo, N. Y., has been chartered with a capital stock of $50,000 to manufacture household specialties and electrical supplies. The incorporators are: B. J. Crawford of Gowanda, N. Y.; David and Robert L. Carey of Buffalo, N. Y.

The Dickson Lighting Studios of Pittsburgh, Pa., has filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing electrical appliances. The incorporators are: D. T. R. Dickson, W. A. Frey of Pittsburgh, Pa., and James Gardner of Beaver Falls, Pa.

The Wagner-Hoyt Electric Company of East Orange, N. J., has been incorporated by Harry H. Picking, Charles O. Geyer and Gordon Grand of East Orange. The company is capitalized at $1,000,000 and proposes to manufacture electric motors. The main offices are at 525 Main Street, East Orange, N. J.

The Shepherdstown Light & Water Company of Shepherdstown, W. Va., has been incorporated with a capital stock of $40,000 by W. Howard Hamilton, 1231 Calvert Building; Walter H. Cook, D. O. Reardon and others, all of Baltimore, Md. The company proposes to operate an electric-light plant and water-works system.

The Arlington Light & Power Company of Arlington, Vt., has been incorporated with a capital stock of $50,000. The incorporators are: O. C. F. Kinum of Schenectady, N. Y.; Albert E. Buck, Victor L. Smith, Truman E. Martin and Martin P. Demmings, all of Arlington, Vt. Gifford & Kinum of Schenectady, N. Y., are engineers.

The Seward Electric Lighting & Power Company of Seward, N. Y., has been incorporated by M. R. Lawrence, T. J. Whalen, 60 Broadway, New York, N. Y., and P. V. Lawrence, 10 Montgomery Street, Brooklyn, N. Y. The company is capitalized at $50,000 and proposes to generate and transmit electricity for lamps, heaters and motors.

The Broad River Electric Power Company of Cliffside, N. C., has been incorporated with a capital stock of $500,000 to construct and operate hydroelectric power plant in Rutherford County to supply electricity in Cliffside and other towns and villages in Rutherford County. R. R. Haynes of Cliffside, Charles H. Haynes and Caeser Cone of Greensboro, N. C., are among the incorporators.

The Bureau of Electric Sign Engineering of Milwaukee, Wis., has filed articles of incorporation with a capital stock of $10,000 and proposes to furnish electric sign data to central stations, electrical contractors and electric sign men; also to manufacture parts of and complete electric signs and electrical advertising specialties. The officers are: J. B. Lindl, president; Joseph Lindl, vice-president; W. G. Garrett, secretary, and W. O. Meilhan, treasurer.

Trade Publications

Pipe Cutters.—The Borden Company, Warren, Ohio, has recently issued a booklet describing its "Beaver" die stocks and square-end pipe cutters.

Voltage Regulators.—Bulletin No. 45402, published by the General Electric Company, Schenectady, N. Y., describes and illustrates feeder voltage regulators.

Screwless Glass Holder.—H. G. McFaddin & Company, 38 Warren Street, New York, are distributing an illustrated folder descriptive of their screwless holders.

V-Notch Recording Liquid Meter.—The Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa., is sending out a card on its "Lea" V-notch recording liquid meter.

Wiring Devices.—The Chelten Electric Company, Philadelphia, Pa., has issued an attractively illustrated catalog which lists various types of electrical wiring devices.

Talking-Machine Winder.—Circulars describing a small motor for winding talking machines, have been issued by Jones-Motrola, Inc., 171 Madison Avenue, New York.

Instantaneous Water Heater.—The Foster Electric Company, Colton, Cal., has prepared an illustrated folder descriptive of its cubical instantaneous electric water heater.

Oil Engines.—Fairbanks, Morse & Company, Chicago, Ill., have issued Catalogue 92B and bulletins No. H192C and No. H178B which describe and illustrate their "Semi-Diesel" oil engines.

Insulator Clamp.—Edwin G. Hatch, Equitable Building, New York, has prepared an illustrated leaflet descriptive of an insulator clamp which is designed to take the line angle without kinking or straining the line.

Automobile Lighting and Ignition Switches.—Bulletin No. 15, published by the Hartman Electrical Manufacturing Company, Mansfield, Ohio, is descriptive of several types of lighting and ignition switches for automobiles.

Recording Instruments.—The Bristol Company, Waterbury, Conn., has just issued several illustrated folders descriptive of its recording thermometers and its long-distance electric transmitting and recording systems.

Oil Filters.—Bulletin No. 5, entitled "Oil Filters," recently issued by the Richardson-Phenix Company, Milwaukee, Wis., describes a complete line of filters for purifying lubricating oil, with capacities of from 25 gal. per day to 50,000 gal. per hour.

Electric Water Heater.—The K. D. Manufacturing & Sales Company, 74 New Montgomery Street, San Francisco, Cal., is sending out an illustrated leaflet descriptive of its instantaneous electric water heater which may be attached to an ordinary hydrant.

Lubricating Compound.—The Texas Company, 17 Battery place, New York, has issued an illustrated booklet which contains information on "Texaco Crater Compound," which is a lubricant designed to save gears and preserve wire rope, chains and bearings.

Renewable Cartridge Fuses.—The Economy Fuse & Manufacturing Company, Kinzie and Orleans Streets, Chicago, Ill., is sending out an illustrated folder which contains information on its renewable cartridge fuses and which shows a number of reorders for these devices.

Electric Linotype Metal Pot.—The Mergenthaler Linotype Company, Tribune Building, New York, is sending out an illustrated folder and a bulletin which contain information on and illustrations of an electrically heated linotype metal pot manufactured by the Cutler-Hammer Manufacturing Company.

Fluid and Boiler Meters.—Bulletins No. 1 and No. 5, prepared by the Bailey Meter Company, Boston, Mass., contain a large amount of information on fluid meters, boiler meters, pressure recorders, etc. The fluid meter and the boiler meter described in these bulletins were recently the subject of articles published in these columns.

Protective Systems for Service Connections and Watt-Hour Meters.—The Metropolitan Engineering Company, 35 Vestry Street, New York, is sending out an illustrated catalog entitled "The Metropolitan Standard Protective System," which contains information on protective equipment for service connections and watt-hour meters.

New England

NEWPORT, ME.—The Central Maine Power Company of Augusta has applied to the Public Utilities Commission for permission to purchase the property and holdings of the Newport Light & Power Company.

VINALHAVEN, ME.—The Islands Electric Company of Rockland has applied to the Public Utilities Commission for permission to supply electricity in Vinalhaven and North Haven; also to issue $60,000 in capital stock and $60,000 in bonds, the proceeds to be used to purchase the property of the Vinalhaven Electric Company.

NEW IPSWICH, N. H.—Negotiations are under way between the town officials and the Derry (N. H.) Electric Company for lighting the streets and public buildings in New Ipswich with electricity.

BELLOWS FALLS, VT.—The installation of a municipal electric-light plant in Bellows Falls is under consideration.

BOSTON, MASS.—Work will soon be started on the construction of a large manufacturing building 212 ft. by 105 ft., at Summer and C Streets, South Boston, for the Western Electric Company. The building will be equipped with elevators, conveyors, electric light and power and mechanical appliances. The contract has been awarded to the W. K. Kearns Company of Boston, George F. Shepard is architect.

LOWELL, MASS.—The Council has granted the Lowell Electric Light Corporation permission to extend its conduits in portions of Central, Thorndike and in East Merrimack Streets.

SHIRLEY, MASS.—The Shirley Electric Company has begun work on the erection of a 33,000-volt electric transmission line to Pepperell, a distance of 10 miles. The company will soon start work on the construction of a transmission line from Pepperell to Hollis, N. H.

WESTFIELD, MASS.—Owing to the high cost of copper wire, etc., the Municipal Electric Light Department has decided not to erect a transmission line to extend its service to Wyben this year.

BRIDGEPORT, CONN.—Bids will be received by the Board of Contract and Supply, Bridgeport, Conn., until June 24 (extension of date from June 17) for construction of municipal ice and storage building, including insulation and elevator; also for equipment for municipal ice-making and cold-storage plant. Plans and specifications may be obtained on application to Fletcher-Thompson, engineers, upon deposit of $25 for each set of plans.

NORWICH, CONN.—The contract for the construction of a four-story reinforced concrete building, 80 ft. by 100 ft., with a power house adjoining, has been awarded to the E. J. Cross Company of Worcester, Mass., by the Winchester Woolen Company. The cost of the building is estimated at $90,000.

Middle Atlantic

BATAVIA, N. Y.—George Warren Fuller, consulting engineer, 170 Broadway, New York, has been engaged to examine and report to the City Council on plans of Chester & Fleming of Pittsburgh, Pa., and I. Lundgaard of Rochester on proposed plans for city improvements. Different schemes for installing a pure water system, and improved electric-light plant and sewage pumping system have been presented by both the Pittsburgh and Rochester engineers.

BROOKLYN, N. Y.—Bids will be received by L. H. Pounds, borough president, Borough Hall, Brooklyn, until June 21 for furnishing material and labor for general construction, including electric work for the reconstruction of the Kings County Court House, at Fulton and Livingston Streets, Brooklyn. Bids will also be received at the same time for plumbing and gas fitting work, heating and ventilating work. Blank forms and further information may be obtained and plans and drawings may be seen at the Bureau of Public Buildings and Offices, 50 Court Street, Brooklyn.

BUFFALO, N. Y.—William F. Schwartz, street commissioner, advocates the substitution of incandescent lamps for the present arc lamps and gas lamps now in use. His plan is to make the change in the principal business streets, next the main arteries and then gradually to extend the zone of new lamps, the entire change to be made in perhaps five years.

HUDSON, N. Y.—Arrangements are being made by the Albany Southern Railroad Company of Hudson to erect transmission lines in Rossman, Columbiaville and Stockport Centre to furnish electrical service in those villages.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

LANCASTER, N. Y.—The Town Board of West Seneca has awarded the Depew & Lancaster Light, Power & Conduit Company of Lancaster a contract to furnish electricity to lighting district No. 3.

MEDINA, N. Y.—The A. L. Swett Electric Light & Power Company of Medina has changed its name to the Western New York Utilities Company. No change has been made in the organization or officers of the company. Albert L. Swett is president.

NEW YORK, N. Y.—Bids will be received by the New York Municipal Railway Corporation until June 19 for furnishing and installing ducts and manholes. For further information apply to the chief engineer, 85 Clinton Street, Brooklyn.

NEW YORK, N. Y.—Bids will be received by Robert Adamson, fire commissioner, Eleventh Floor, Municipal Building, New York, until June 26 for furnishing three motor-driven combination chemical and hose wagons. Bids will also be received at the same time for seven motor-driven hose wagons. Blank forms and further information may be obtained at the above office.

OSWEGO, N. Y.—The Peoples Gas & Electric Company of Oswego is extending its electric transmission lines into the town of Scriba to furnish electrical service there. It is expected that the line will be extended to Lycoming and possibly as far east as the New Haven town line next year. The town of Scriba may also make arrangements to light the highway between Oswego and Scriba Corners. R. F. Whitney is manager of the company.

RANDOLPH, N. Y.—The Public Service Commission has approved the franchises of the Randolph Light & Power Company for electric transmission lines and distribution system in the town of Villenova and the village of South Dayton. The company is erecting a transmission line from Cherry Creek through the town of Villenova to South Dayton and will also distribute electricity to the residents along the Mile Strip Road in Villenova.

WEST NEW BRIGHTON, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until June 26 for additions and alterations in the electric equipment in Public School 18, Broadway, West New Brighton, borough of Richmond. Blank forms, plans and specifications may be seen or obtained at the above office and also at branch office, Borough Hall, New Brighton.

FALMOUTH, PA.—Arrangements are being made for the installation of an electric-lighting system in Falmouth. Energy will be supplied by the York Haven Water & Power Company. Work has begun on the erection of the system.

GREENSBURG, PA.—The Roberts Fertilizer Company contemplates rebuilding its present building and the erection of a new building, 30 ft. by 40 ft., two stories high. New machinery, including elevator, engine, boiler, vacuum pumps, deodorizer, packer, two sanitary rendering tanks, etc., to cost about $6,000, will be purchased.

JOHNSTOWN, PA.—The Dale Light, Heat & Power Company is contemplating extensions and improvements to its plant.

LILLY, PA.—Bids will be received by the school board of Lilly until June 19 for construction of high school building. Separate bids to be submitted for heating, electrical work, etc. J. E. Adams, Lincoln Building, Johnstown, is architect. W. L. McGough is secretary of board.

MOUNT WOLF, PA.—The Borough Council has awarded the Edison Electric Light & Power Company of York a contract to install and operate an electric lighting system in Mount Wolf.

NEWTON, PA.—Governor Brumbaugh has approved the consolidation of the Bucks County Electric Company of Newton and the Doylestown (Pa.) Electric Company into the Pennsylvania-New Jersey Power & Light Company with a capital stock of $100,000. Sidney L. Wright of Philadelphia, Pa., is president of the new company and Gaylord Thompson of Trenton, N. J., vice-president.

OSCEOLA MILLS, PA.—The power plant of the Moshannon Coal Company at the Weston Colliery in Osceola Mills was recently destroyed by an explosion, causing a loss of about $12,000.

PHILADELPHIA, PA.—The Electric Storage Battery Company has been granted a permit to erect a brick and concrete manufacturing building, 146 ft. by 115 ft., seven stories high, on Nineteenth Street, south of Allegheny Avenue.

PHILADELPHIA, PA.—Plans are being prepared by the Scofield Engineering Company, Commercial Trust Building, Philadelphia, and De Armond, Ashmead & Bickley, architects, Philadelphia, for a new office building for the Franklin Trust Company. There will be a twelve story office building with a power house across the alley in a separate building.

BAYONNE, N. J.—The City Commission has entered into an agreement with the Public Service Electric Company for the installation of an ornamental arc-lighting system on Broadway for a period of five years, and for an expenditure of $25,000 during the present year in substituting underground conduit lines for the present overhead construction. The company also agrees to expend $10,000 annually for a period of ten years in placing its wires underground in other sections of the city.

BRIDGETON, N. J.—The Bridgeton Electric Company is extending its electric transmission lines to Gouldtown to furnish electrical service there.

HACKETTSTOWN, N. J.—E. W. Lathrop of Philadelphia, Pa., it is reported, has arranged for the purchase of the property of the Hackettstown Electric Light Company. The plant, it is understood, will be taken over about July 1.

JERSEY CITY, N. J.—Bids will be received by the Board of City Commissioners of Jersey City, until June 20, for electric and gas fixtures for the laboratory at the high-service pumping station. Michael I. Fagen is city clerk.

MORRISTOWN, N. J.—The Morris County Traction Company is planning to erect a new transformer station in the vicinity of Kenvil, with a new pole line to connect with the Dover transmission system.

SUMMIT, N. J.—Plans are being considered by the Rahway Valley Railroad Company, which operates a railroad from Summit to Aldene, to equip its line for electrical operation. J. S. Caldwell of Kenilworth, N. J., is general manager.

BLUEFIELD, W. VA.—The Appalachian Power Company, of Bluefield, is extending its transmission line to the mines of the Clinchfield Coal Corporation at Dante, Va., a distance of 80 miles, and to points intermediate.

WARWOOD, W. VA.—The Brooke Electric Company of Warwood (post office Wheeling) has been granted a permit by the County Commissioners to erect a high-tension transmission line from the plant of the American Gas & Electric Company, at Beech Bottom, W. Va., to Washington, Pa.

CLIFTON FORGE, VA.—The capital stock of the Virginia Western Electric Company of Clifton Forge has been increased from $500,000 to $1,000,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 24 for two 350-hp. boilers and a steel stack for naval station at Island of Guam.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations the following supplies: Philadelphia, Pa., Schedule 9782—2000 steel wire casting brushes, 430 crucibles without covers; Schedule 9783—miscellaneous magnet wire. Boston or Newport, R. I., Schedule 9757—three air compressors. Brooklyn, N. Y., Schedule 9779—48 ½-in. portable electric drills. 12 electric bench grinders; Schedule 9758—miscellaneous plate steel fans; Schedule 9759—furnishing and installing miscellaneous ice-making machinery; Schedule 9783—20 ventilating sets; Schedule 9774—29,500 ft. rubber-covered wire. Norfolk, Va., and Mare Island, Cal. Schedule 9770—16 main air, fuel oil pumps, etc.; Norfolk, Va., Schedule 9782—miscellaneous steel boiler rivets; Schedule 9779—miscellaneous steel tubing. Newport, R. I. Schedule 9762—8200 ft. single-conductor cable; Schedule 9763—miscellaneous seamless brass tubing, miscellaneous bronze tubing. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Commerce reports as follows: No. 21,330—An American consular officer in the United Kingdom reports that a man in his district desires to receive quotations on carbons used for cinematographs measuring 12 in. in length by 16 and 22 mm. He is also in the market for metal filament bulbs for flash-lamp batteries. No. 21,335—A manufacturer of motors in the Netherlands advises the bureau that he desires to

import four-cycle stationary kerosene engines. He also desires to have made in the United States from his drawings cylinder castings for one and two-cylinder, four-cycle engines, 120 mm. bore and 150 mm. stroke. No. 21,345—A firm in Holland wishes to represent in Scandinavian countries American manufacturers and exporters of electrical machinery, electrical novelties, electric fans, valves, gauges, general hardware and novelties of all kinds. No. 21,397—An American consular officer in Spain reports that a firm in his district, which deals in scientific apparatus and materials of all kinds, is desirous of importing tape measures, rulers, thermometers of all kinds, compasses, small electrical material, incandescent lamps, field glasses, microscopes, insulators, electromedical appartus, apparatus for electric heating and domestic use, water meters, electric ventilators, electric motors, apparatus for physics, topography and meteorology. Correspondence may be in English. No. 21,398—A firm in Chile informs an American consular officer that it desires to enter into commercial relations with manufacturers and exporters of machinery and steel products, etc., used in connection with the nitrate-reduction industry and other goods, such as iron and steel beams, plates, rails; machinery, automobiles and accessories; lubricants, oils, asbestos, paints, belting, electrical material, pig iron and white metals of all kinds. No. 21,425—An electric power company in Spain informs an American consular officer that it desires quotations on a 350 to 400-hp. gas engine of the Diesel type, or any other easy starting system, for quick delivery. No. 21,427—A man in Russia requests an American consular officer to place him in touch with manufacturers of refrigerating machinery, elevators and technical supplies. Correspondence may be in English. No. 21,440—An American consular officer in South Africa transmits the name and address of a firm in his district which desires to receive quotations on a small cottonseed oil refining plant. The plant is to be operated by electricity. No. 21,477—A man from Russia, who is now in the United States, wishes to represent American manufacturers and exporters of electrical supplies, washing machines, laundry equipment, vacuum cleaning machinery, agricultural machinery and supplies, etc. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its branch offices.

North Central

FLINT, MICH.—The general contract for the construction of the new parish house of the St. Paul's Episcopal Church has been awarded to C. M. Maliskey & Son of Owosso for $50,000. Contracts for plumbing, heating, lighting and fixtures will be awarded later.

FLINT, MICH.—The Trojan Laundry Company of Flint, recently incorporated with a capital stock of $100,000, is planning to erect a laundry plant across the river from the Grand Trunk Railway station. The building will be equipped throughout with electrically operated machinery.

GRAND RAPIDS, MICH.—Bids will be received by H. N. Morrill, business manager of the board of education, City Hall, Grand Rapids, until July 3 for addition to the Union High School, including general construction, plumbing, heating and ventilation, temperature control, vacuum cleaning apparatus, wiring, etc., as per plans and specifications on file in the office of H. H. Turner, 234 North Division Avenue, Grand Rapids.

HESPERIA, MICH.—Application has been made to the City Council by Reed & Speese of Whitehall to supply electricity for lamps and motors in Hesperia. The company proposes to build a hydroelectric plant on the White River.

HOUGHTON, MICH.—Preliminary work has started on the proposed improvements to the power plant of the Houghton County Electric Light Company. The work will include an addition, 25 ft. by 48 ft., to the boiler house and installation of a 600-hp. boiler; the erection of a new smoke stack; the roof of the present boiler house will be raised and new equipment installed. A new 2500-kw. General Electric turbo-generator, with condenser, new ventilation system will be installed and other improvements made to engine house. The Stone & Webster Engineering Corporation of Boston, Mass., has the contract for the work.

JACKSON, MICH.—All bids submitted May 26 for additions and improvements to the municipal electric plant have been rejected. S. W. Bruce is village recorder.

BALTIC, OHIO.—The Village Council has granted the Sugar Creek Light, Heat & Power Company a franchise to establish an electric-lighting system in Baltic.

CINCINNATI, OHIO.—The report submitted by City Electrician Kleine shows the wiring system of the City Hall to be in very bad condition. Estimates of the cost of rewiring the building throughout will soon be made.

CINCINNATI, OHIO.—The contract for the construction of a branch building and exchange at Woodburn Avenue and Locust Street, to cost about $90,000, has been awarded by the Cincinnati & Suburban Telephone Company.

WASHINGTON C. H., OHIO.—Bids will be received by the Service-Safety Director of the city of Washington, Fayette County, Ohio, until June 30, for the installation of a complete new lighting system for lighting the streets, alleys, public buildings with electricity, consisting of approximately 41 bracket lamps or center suspension lamps of 100 cp.; also 36 bracket or center suspension lamps of 250 cp., with refractors for a period of ten years. James J. Flyn is clerk.

EARLINGTON, KY.—The city of Earlington is contemplating the construction of a municipal electric-light plant, to cost about $20,000.

GARY, IND.—Plans are being considered by the Gary & Interurban Railroad Company for rehabilitation of its lines to Gary and the construction of a railway on Buchanan Street in Gary, at a cost of about $300,000.

TOPEKA, IND.—The Hawks Electric Company of Goshen has petitioned the Public Service Commission for permission to purchase the local electric plant, owned by S. P. Hull, at $5,800. If the plant is taken over by the Hawks company, its electric transmission line will be extended from Millersburg to Topeka, a distance of about 10 miles.

ARENZVILLE, ILL.—Plans are being considered for the installation of an electric-light plant in Arenzville. J. G. Pratt and others are interested.

CHICAGO, ILL.—The City Council has authorized the traction company to build street-car lines in Canal Street from Kinzie Street to Archer Avenue and in Lake Park Avenue from Forty-seventh to Fifty-fifth Street.

CHICAGO, ILL.—Bids will be received by the South Park Commissioners, Fifty-seventh Street and Cottage Grove Avenue, Chicago, until June 21 for cable wire, transformers and electric apparatus for use in lighting system on Michigan Avenue. J. F. Neil is secretary of commission.

DUNNING, ILL.—Bids will be received by the Board of Administration, Capitol Building, Springfield, Ill., until June 27 for furnishing and installing water mains to and from the new power plant at the Chicago State Hospital at Dunning. Plans and specifications may be obtained upon written application to Dr. George Leininger, managing officer, Dunning.

DUNNING, ILL.—Bids will be received by the Board of Administration, Capitol Building, Springfield, Ill., until June 27 for construction of an amusement hall at the Chicago State Hospital at Dunning. Separate bids to be submitted on general work, electrical, heating and plumbing work. Plans and specifications may be obtained upon application to James B. Dibleka, state architect, 130 North Fifth Avenue, Chicago.

OREGON, WIS.—The proposal to grant an electric-light franchise in Oregon will soon be submitted to the voters.

OSHKOSH, WIS.—Tentative plans have been submitted to the City Council by W. A. Baehr of Chicago, Ill., consulting engineer, for a new street-lighting system in Oshkosh.

SHAWANO, WIS.—Bids will be received by the city clerk of Shawano until June 27 for construction of dam and power house. The work will consist of a concrete dam with a 230-ft. spillway, brick power house, two concrete flumes, wing walls, core walls, apron for dam, all of reinforced concrete; also including electrical equipment, water wheel and governor, erection of transmission lines and furnishing materials, with the exception of poles, which will be furnished by the city, to transmit electricity generated at the dam to the city of Shawano. The city will furnish a rock crusher and the necessary rock to be used in the construction work. Bids will be received for the entire work; separate bids may also be submitted on different parts of the work. Plans and specifications are on file in the office of the city clerk, Shawano, Wis., and at the office of the Power Engineering Company, Minneapolis, Minn., consulting engineers.

STEVENS POINT, WIS.—The Wisconsin River Pulp & Paper Company is contemplating the construction of a concrete dam on the Wisconsin River, to cost about $75,000.

SUN PRAIRIE, WIS.—Bids will be received by the Village Board of Sun Prairie until July 3 for the following machinery: One 65-hp. unaflow non-condensing engine suitable for direct connection to a 40-kw., 250-volt direct-current generator, rheostat included, engine to operate at 100 lb. steam pressure. For details see proposal columns.

WEST ALLIS, WIS.—Plans are being considered by the John Obenberger Forge Company for the construction of a power plant and shops, to cost about $100,000.

APPLETON, MINN.—The Otter Tail Power Company of Fergus Falls has submitted a proposal to the village of Appleton offering to purchase the municipal electric-light plant, at $9,000 and to rebuild and re-equip the system.

CALEDONIA, MINN.—The Root River Light & Power Company is planning to extend its transmission line from Spring Grove to Caledonia.

CANNON FALLS, MINN.—The Northern States Power Company contemplates the construction of another large dam in Cannon Falls.

GIBBON, MINN.—The Northern States Power Company of Duluth is contemplating the erection of a transmission line through Henderson, Gaylord, Gibbon and Fairfax.

JANESVILLE, MINN.—The town of Janesville is considering the installation of an ornamental lighting system, which will be maintained by electricity furnished by the Northern States Power Company (Faribault division).

PROCTOR, MINN.—Bids will be received by the Board of Education, Proctor, Minn., until June 24 addressed to H. J. Barncard, clerk of Independent School District No. 1, for construction of school building, separate bids to be submitted as follows: General contract, heating and ventilating, heat regulation, plumbing, hardware, electric wiring and power systems. Plans and specifications may be obtained on application to the clerk or Vernon J. Price & Co., architects, Duluth, Minn., upon deposit of $20.

WATERVILLE, MINN.—The city officials are considering the installation of additional lamps and larger units for lighting the business section of the town. The Northern States Power Company (Faribault division) expects to secure contract soon for pumping the city water supply.

COLUMBUS JUNCTION, IOWA—The Louisa County Power Company, recently incorporated with a capital stock of $25,000, proposes to supply electricity in Columbus Junction and vicinity. R. L. Van Meter of Sigourney and A. J. Lundquist of Columbus Junction are interested in the company.

DAYTON, IOWA—At an election to be held June 19 the proposal to issue $15,000 in bonds for the installation of an electric-lighting system in Dayton will be submitted to the voters.

FAIRFIELD, IOWA.—The Home Gas, Light & Power Company, recently incorporated with a capital stock of $10,000, proposes to generate and distribute electricity for lamps, heaters and motors. Vernon L. Hague and others are interested.

PETERSON, IOWA—The Peterson Power & Milling Company, it is reported, will soon ask for bids for construction of power plant, to cost about $15,000.

BROOKFIELD, MO.—Plans are being prepared by E. E. Harper, engineer, Kansas City, Mo., for a municipal electric-light plant in Brookfield, to cost from $50,000 to $60,000.

CONCORDIA, MO.—The Concordia Light & Power Company, recently incorporated with a capital of $15,000, proposes to establish an electric-light and power plant here and to deal in electrical appliances. W. S. McCall, R. W. Morrison and H. C. Loehr are the incorporators.

ELVINS, MO.—The Missouri Public Utilities Company of Cape Girardeau has applied to the Public Service Commission for authority to exercise an electric franchise in Elvins.

MARSHALL, MO.—An election will soon be called to submit to the voters the proposal to establish a municipal electric-light plant, to cost about $70,000. Henrici, Kent & Lowry, Reserve Bank Building, Kansas City, Mo., are consulting engineers.

ELKTON, N. D.—Plans have been prepared for the installation of an additional hydraulic and electric generating unit at the plant of the Gilpen Falls Electric Company. This installation will double the output of the plant.

GRAFTON, N. D.—Plans are being considered by the Red River Light & Power Company of Grand Forks to extend its transmission lines to Grafton and Park River.

ROLETTE, N. D.—The installation of an electric-light plant in Rolette is under consideration.

CAVOUR, S. D.—Plans are being prepared for the installation of an electric-lighting system in Cavour.

LETCHER, S. D.—The Mitchell (S. D.) Power Company has been granted a franchise to construct and operate an electric-light and power system in Letcher.

BLUE HILL, NEB.—Plans have been approved by the City Council for a municipal electric-light plant and water-works system.

CLARKS, NEB.—The Central Power Company of Grand Island, which has been granted a 25-year franchise and awarded a contract for lighting the streets of the village and for furnishing electricity for pumping water for a period of ten years, is erecting a transmission line from Central City to Clarks to furnish the service. The company is now installing a new distributing system in the village. When the new system is completed the municipal plant will be closed down and the generating equipment and material for distributing system disposed of by the village of Clarks. T. H. Fritts of Grand Island is vice-president of the company.

SCOTIA, NEB.—At an election held recently the proposal to issue bonds for the installation of an electric-light plant and water-works system was carried.

STELLA, NEB.—Bonds to the amount of $8,000 have been voted for the installation of an electric-lighting system.

FORT SCOTT, KAN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 7 for a new boiler for the United States post office and court house at Fort Scott. For details see proposal columns.

OAKLAND, KAN.—The city of Oakland has authorized the Topeka Edison Company to install an electric-lighting system here.

WELLSVILLE, KAN.—The Wellsville Electric Light & Power Company is considering the purchase of a gas engine of about 50 hp., a good second-hand one preferred, as a reserve unit for emergency purposes. The company desires to trade an old Western Electric 12-kw., 120-volt, direct-current generator with fly wheel, rheostat, etc., all in good condition, and a new 15-kva., 2300-volt, 60-cycle, three-phase Electric Machinery Company generator, with exciter, rheostat, etc., for a 35 to 40-kva., 60-cycle, three-phase, 2300-volt generator complete. For further information address C. A. Smith, owner.

Southern States

LUMBERTON, N. C.—Bonds to the amount of $30,000 have been voted for improvements to electric-light plant and water-works system.

CAMDEN, S. C.—The City Council contemplates submitting to the voters the proposal to issue $7,000 in bonds for improvements to the municipal electric-lighting system.

SPARTANBURG, S. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 5 for a new boiler, etc., for the United States post office at Spartanburg. For details see proposal columns.

CHATTANOOGA, TENN.—The Land Investment Company, recently incorporated, is reported to have purchased property in and around Green's Lane. The company will utilize the water power of lake to generate electricity. An engineer has been engaged to prepare plans for the proposed plant.

KNOXVILLE, TENN.—The city of Knoxville has awarded a contract to the Knoxville Railway & Light Company for the installation of 100 additional ornamental lamps, at $9,000.

MANCHESTER, TENN.—The Public Light & Power Company, it is reported, is planning to construct an entirely new plant to be operated by water power. It is proposed to supply electrical service to a number of towns in this vicinity.

MEMPHIS, TENN.—Bids will be received at the U. S. Engineer office, Custom House, Memphis, Tenn, until July 3 for furnishing galvanized wire, wire strand, wire cables, clips, pure manila bolt wire and rubber hose. Further information on application.

ATMORE, ALA.—A company, it is reported, is being organized by W. D. Owens, J. E. McCoy, and others, for the purpose of developing water power on Perdido River to generate electricity for transmission to cities and towns in Baldwin County and in portions of West Florida.

BIRMINGHAM, ALA.—At an election held recently the proposal to issue $500,000 in bonds for the construction of a muncipal electric-light plant was carried.

LITTLE ROCK, ARK.—Plans are being considered by the Arkansas Hydroelectric Development Company, recently incorporated, for the construction of a hydroelectric power plant on the Little Red River in Central Arkansas for the purpose of supplying electricity in Little Rock, Memphis and West Memphis, Tenn. The power plant will be located about 83 miles from Memphis. Dr. A. R. Amos of Little Rock is president of the company.

HYDRO, OKLA.—The city of Hydro has granted J. D. Palmer a franchise to install and operate an electric-light system here.

NEW WILSON, OKLA.—All bids submitted May 3 for construction of an electric-light plant and water-works system have been rejected. The city, it is understood, will build the plants. The work will include construction of power house, including equipment, distributing system, etc. The Benham Engineering Company, Colcord Building, Oklahoma City, has charge of the engineering work.

WANETTE, OKLA.—An election will soon be held to submit to the voters the proposal to issue $8,000 in bonds for the installation of a municipal electric-light plant.

MARBLE FALLS, TEX.—The National Hydro-Electric & Construction Company, which began the construction of a dam across the Colorado River at Marble Falls several years ago, as a preliminary step toward the construction of a hydroelectric plant, has succeeded in financing the project and will carry it to early completion according to an announcement of H. Alexander, of Dallas, president of the company. It is proposed to erect high-tension transmission lines to San Antonio and other cities and towns in this part of the State.

MERTENS, TEX.—Arrangements have been completed by the Texas Power & Light Company of Dallas for the erection of an electric transmission line from Mertens to Malone and Irene.

WYLIE, TEX.—The Texas Power & Light Company, of Dallas, has recently purchased the local electric-light plant owned by Sibley & McDonald. Improvements will be made to the local system, including the construction of a substation and establishing a 24-hr. service. A transmission line will be erected from Murphy to operate its system here.

Pacific States

BAKER, ORE.—The Idaho-Oregon Power Company, of Boise, it is reported, will begin immediately on the erection of a high-tension transmission line to the Irondyke and Homestead mines, to supply electricity to operate machinery in the mines.

PORTLAND, ORE.—Bids, it is understood, will soon be asked for electric wiring and fixtures for the new municipal auditorium, now under construction. Whitehouse & Fouilhoux, Wilcox Building, Portland, are architects. A. L. Barbour is city auditor.

RIDDLE, ORE.—A. E. Brais, it is reported, has accepted a franchise providing for the installation of an electric-light plant in Riddle.

SAN FRANCISCO, CAL.—The Great Western Power Company of San Francisco, it is reported, has acquired the Humbug Valley property formerly owned by the Oro Electric Corporation of Oroville. The property will be used by the Great Western Power Company in the development of a series of large power plants. It is proposed to divert the water by a series of tunnels, flumes and concrete ditches from the Big Meadows dam to Humbug Valley, where it will be dropped to the North Fork of Feather River to the new power plant.

SAN FRANCISCO, CAL.—Bids will be received at the office of the depot quartermaster, United States Armory, Fort Mason, San Francisco, Cal., until June 28 for furnishing the following supplies: 325 dry batteries, 1000 ft. duplex cable, 110 oil cans, 150 hawser cabins, 284 electric fittings, 228 steam globes, 36 signal lamps, 200 pair steam lines, 2000 ft. electric cables, 10,000 ft. iron pipe, 540 marine signals, 200 ft. antenna wire, 2500 lb. wire strand, etc. For further information address W. H. Hart, Lt. Col. quartermaster corps, U. S. army depot quartermaster.

CALDWELL, IDAHO.—The City Council has entered into a 10-year contract with the Electrical Investment Company for the installation of a new street-lighting system. Under the terms of the contract the company will furnish 23 nitrogen lamps of 400 cp.

COEUR D' ALENE, IDAHO.—The City Council is considering the installation of a municipal electric-light plant and water-works system.

McCAMMON, IDAHO.—The Public Service Commission has granted the village of McCammon a certificate of public convenience and necessity to install a municipal electric-lighting system.

POCATELLO, IDAHO—An ordinance has been passed by the City Council creating improvement district No. 15. The plans provide for lighting the streets either by gas or electricity, at a cost of about $70,799. The district includes practically all the business and residential sections.

WICKENBURG, ARIZ.—At an election to be held July 1 the proposal to issue $17,000 in bonds for the installation of a municipal electric-light plant and addition to water-works system will be submitted to the voters.

HARLOWTON, MONT.—The Montana Power Company, of Butte, is reported to have obtained an option on the plant of the Harlowton Light & Water Company. If the deal goes through the power company will build a substation here and will establish a 24-hr. service.

BURNS, WYO.—The installation of an electric-lighting plant in Burns is under consideration. The plans provide for a complete lighting, power and storage plant, giving a 24-hour service. W. C. Costin is interested in the project.

LOVELAND, COL.—Bids will be received by George C. Rist, city clerk, Loveland, until July 3 for construction of a tunnel for the proposed hydroelectric power plant for the city of Loveland. The work is located on the south side of the Big Thompson River about 16 miles west of Loveland and consists of about 800 ft. of 4 ft. by 5 ft. tunnel. Plans and specifications may be seen in the office of the city clerk, Loveland, or at the office of the city engineer, Kistler Building, Longmont, Col.

ALAMOGORDO, N. M.—The city of Alamogordo has taken over the properties of the Alamogordo Light, Power & Water Company for a consideration of $300,000. Improvements will be made to the electric-light and water-works systems.

FORT STANLEY, N. M.—Plans are being considered for the construction of a 1,000,000-gal. concrete reservoir, equipped with electrically driven pumps and pipe line to the Marine Sanitarium at Fort Stanton on Rio Bonito in Lincoln County. For further information address superintendent of Marine Sanitarium.

Canada

VANCOUVER, B. C.—The Western Canada Power Company is installing a third unit in its power plant at Stave Falls. The waterwheel has a rating of 13,000 hp.

WINNIPEG, MAN.—The city controllers have decided to recommend to the City Council the purchase of a new motor to drive the 5,000,000-gal. pump at the McPhillips Street water-works plant to replace the motor now in use.

STAMFORD, ONT.—The Council has adopted a resolution favoring the plan of the Ontario Hydro-Electric Commission to take over the system of the Ontario Distributing Company. The proposal will soon be submitted to the ratepayers and if approved arrangements will be made to appropriate $30,000 to purchase the plant.

MOOSE JAW, SASK.—The City Council has decided on improvements to the municipal electric-light plant involving an expenditure of $12,300, which will include extension of transmision lines, replacing old lines with heavier wire and improvements to equipment in power house.

Miscellaneous

PANAMA.—Bids will be received at the office of the assistant purchasing agent, the Panama Canal, 24 State Street, New York, N. Y., until July 17 for the purchase of 100-kw., 200-kw. and 400-kw., direct-connected alternating-current generators offered for sale by the Panama Canal. For details see proposal columns.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until June 23 for steel angles and plates, sheet copper, copper bussing, brass wire, copper wire, panel boards, panel circuits, electric switches, electric terminals, watthour meters, condulets, etc. Blanks and general information relating to this circular (No. 1053) may be obtained from the above office or from the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

1,185,635. Automatic Telephone Exchange System; G. Deakin, San Francisco, Cal. App. filed March 27, 1912. Improved party line ringing circuit.

1,185,645. Attachment for Converting Oil Lamps Into Electric Lamps; J. H. Faw, Morsemere, N. J. App. filed Nov. 12, 1913. Readily applied to ordinary automobile oil lamp.

1,185,646. Electrical Lamp Socket and Switch; J. H. Faw, Morsemere, N. J. App. filed July 27, 1914. Simplified socket construction with self-contained switch.

1,185,648. Motor; F. H. Feraud, Granite City, Ill. App. filed Oct. 24, 1914. Particularly for winding clocks, etc.

1,185,673. Electrically Heated Utensil; D. C. G. Hughes, Chicago, Ill. App. filed July 8, 1915. Percolator construction.

1,185,680. Resonant Amplifying Receiver; A. G. Keplinger, Kansas City, Kan. App. filed Nov. 14, 1914. Receiver with regulatable resonant and amplifying chamber.

1,185,685. Vapor Electric Apparatus; C. A. Kraus and R. D. Mailey, Newton Highlands and Lynn, Mass. App. filed June 30, 1910. Has a metal container.

1,185,690. Electric Switch; G. W. Lawrence, Cranford, N. J. App. filed July 30, 1915. Permutation construction for automobile ignition.

1,185,700. Insulator for Trolley Wires; B. C. Moss, Kansas City, Mo. App. filed Jan. 11, 1915. Of universal application for different situations.

1,185,711. Receiver for Wireless Telegraphy and Telephony; G. W. Pickard, Amesbury, Mass. App. filed March 9, 1910. Receives oscillations converted into direct current by abrupt change in character of receiving circuit.

1,185,712. Isochronizing and Synchronizing System; P. M. Rainey, Glen Ridge, N. J. App. filed Aug. 18, 1914. Particularly for multiplex printing telegraphy.

1,185,720. Recording Target; S. A. M. Rose, Westminster, London, England. App. filed Feb. 6, 1911. Flexible strip target arrested by shot.

1,185,729. Electric Sad Iron; N. E. Starr, Township 15, Neb. App. filed Aug. 28, 1914. Provides for three degrees of heat.

1,185,738. Electropneumatic Brake; W. V. Turner, Edgewood, Pa. App. filed Feb. 23, 1915. Insures reduction in brake-pipe pressure.

1,185,740. Combined Vehicle Lamp and Horn; N. B. Wales, Boston, Mass. App. filed Oct. 18, 1912. Horn built into back of lamp.

1,185,749. Oil Switch; H. A. Yearick and E. Schreiber, Sunbury, Pa. App. filed Oct. 2, 1914. Partition operates oil chamber from lead wires and operating lever.

1,185,750. Bonding Device for Rails; A. A. Ziegler, Boston, Mass. App. filed June 23, 1913. Washers for supporting intermediate portion of bonding wires.

1,185,788. Secondary or Storage Battery; B. Ford, Philadelphia, Pa. App. filed March 2, 1914. Improved terminal construction.

1,185,792. Seat Indicator; H. J. Hansen, Seattle, Wash. App. filed June 8, 1914. Lights indicate group of seats which are vacant.

1,185,814. Electric Signal; J. F. McElroy, deceased, Albany, N. Y. App. filed Jan. 22, 1910. Reserve signal becomes operative in event of first signal becoming disabled.

1,185,843. Selective Signaling Apparatus; M. Setter, Chicago, Ill. App. filed June 6, 1906. Selective ring key for party lines.

1,185,849. Heater; F. C. Smith, Port Arthur, Tex. App. filed Dec. 16, 1915. For motor-vehicle water cooling system.

1,185,851. Electric Switch; O. T. Snyder, Columbus, Ohio. App. filed Nov. 11, 1914. Push rod operated.

1,185,878. Telephone Amplifier; J. J. Comer, Chicago, Ill. App. filed May 6, 1912. Particularly for transmitting music.

1,185,879. Telephone System; J. J. Comer, Chicago, Ill. App. filed Dec. 19, 1912. Improved circuit arrangement for transmitting vocal or instrumental music.

1,185,893. Attachment for Electric Flash Lamps; H. Ennis, Layland, W. Va. App. filed Nov. 24, 1915. Pocket flash lamp with needle attachment for opening clogged tube of carbid lamp.

Record of Electrical Patents

Notes on United States Patents issued June 6, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,185,919. Signaling System; E. H. Long, Oakland, Cal. App. filed Dec. 6, 1911. Avoids transmission of interfering signals.

1,185,938. Telephone Exchange; C. L. Redfield, Chicago, Ill. App. filed Feb. 13, 1905. Simplified party line.

1,185,946. Plating Machine; L. Schulte, Chicago, Ill. App. filed Aug. 9, 1915. Work may be withdrawn from barrel without removing it from the containing tank.

1,185,958. Automatic Train Controlling and Car Signaling System; R. E. Thompson, Seattle, Wash. App. filed Jan. 2, 1914. Box system of signaling and train stopping.

1,185,959. Nickel Anode and Process of Manufacture; J. J. Walsh, Indianapolis, Ind. App. filed June 24, 1915. Utilizes scrap anodes by uniting them to a support.

1,185,978. Electric Hand Lamp; C. F. Burgess, Madison, Wis. App. filed May 28, 1915. More reliable connection between the battery and lamp.

1,185,997. Indication Means for Light Signal; C. O. Harrington, Edgewood Borough, Pa. App. filed May 8, 1914. Indicates whether or not lamps of interlocking machine are burning.

1,185,998. Indicating Means for Light Signals; C. O. Harrington, Edgewood Borough, Pa. App. filed May 8, 1914. Controlled by the currents following in the signal lamp.

1,185,999. Indication Means for Light Signals; C. S. Snavely, Edgewood Borough, Pa. App. filed May 8, 1914. Indicates when lamp is lighted.

1,186,011. Alternating Current Electromagnet; D. L. Lindquist, Yonkers, N. Y. App. filed Feb. 6, 1913. Bar secondary conductor.

1,186,012. Alternating Current Electromagnet; D. L. Lindquist, Yonkers, N. Y. App. filed Feb. 6, 1913. Lamination of solid cubical mass.

1,186,024. Electric Heating System and Thermostatic Control; H. A. Mulvany, Berkeley, Cal., App. filed June 1, 1915. Incubator.

1,186,049. Lock for Telephones; J. S. Stephens, Paterson, N. J. App. filed June 2, 1915. Applicable to ordinary desk phone.

1,186,051. Machine Telephone Switching System; J. N. Wallace, Antwerp, Belgium. App. filed June 28, 1913. Uses both alternating current and direct current.

1,186,057. Operator's Cord Circuit with Reverting Busy Test; C. S. Winston, Chicago, Ill. App. filed Sept. 11, 1913. Relates to common battery and multiple systems.

1,186,083. Primary Battery; E. M. Deems, East Orange, N. J. App. filed Dec. 2, 1914. Parts maintained insulated and separated from containing jar.

1,186,084. Primary Battery; E. M. Deems, New York, N. Y. App. filed June 26, 1915. Special arrangements of elements and support therefor.

1,186,090. Fuse Plug; J. H. Hanson, Chicago, Ill. App. filed Jan. 18, 1915. Has provision to break the arc.

1,186,106. Electrochemical Apparatus; C. P. Landreth, Philadelphia, Pa. App. filed Oct. 14, 1914. For treatment of sewage, etc. (forty claims).

1,186,121. Switch Plug; W. and F. S. Murray, New York, N. Y. App. filed Aug. 5, 1910. Adapted to be readily inserted and drawn from "plugging" box.

1,186,122. Electric Signal Device; G. W. Norgate, Chicago, Ill. App. filed May 9, 1914. "Buzzer" construction.

1,186,158. Means for Charging Storage Batteries; D. C. Anderson, Sewickley, Pa. App. filed March 21, 1914. Varies charging current according to temperature of battery.

1,186,197. Portable Electric Light; C. Hubert, New York, N. Y. App. filed March 20, 1915. Takes an ordinary dry cell.

1,186,198. Portable Electric Light; C. Hubert, New York, N. Y. App. filed May 12, 1915. "House lamp" construction.

1,186,222. Method of Electrical Welding; T. E. Murray, New York, N. Y. App. filed Feb. 18, 1916. Production of wheel hub.

1,186,227. Electromagnet Mount; J. G. Peterson, Jersey City, N. J. App. filed Dec. 24, 1915. Insulation of bell magnet and frame from its base.

1,186,246. Combined Ignition and Radio System; H. R. Van Deventer, Sumter, S. C. App. filed April 20, 1915. High-tension generator for ignition and wireless work.

1,186,253. Projector Carbon; W. G. Wilcox, Lakewood, Ohio. App. filed July 2, 1913. Carbon shell with core of potassium silicate and potassium-silico fluorid.

1,186,270. Means for Controlling Electric Heater Circuits; A. F. Berry, Ealing, England. App. filed June 28, 1915. Mechanically interlocked switches.

1,186,305. Telephonic System; E. A. Graham, W. J. Rickets and E. A. Sanftleben, Brockley, London, England. App. filed May 29, 1914. Three-wire system using electromagnets instead of permanent magnets.

1,186,306. Process of Extracting Metals from Their Ores; W. E. Greenawalt, Denver, Col. App. filed May 7, 1912. Permits foul leaching fluids to be used indefinitely.

1,186,307. Automatic Alarm for Sprinkler Systems; L. A. Grimes, Orange, N. J. App. filed July 8, 1915. Gives indication of an abnormal flow.

1,186,398. Detectophone; J. E. B. Holladay, Suffolk, Va. App. filed Aug. 22, 1913. Induction coil connected in peculiar way.

1,186,422. Electric Flashlight; J. C. Morgan, Los Angeles, Cal. App. filed Oct. 29, 1915. Spring motor-driven generator which can be wound by squeezing handle.

1,186,439. Machine Oil; G. M. Rogers, Chicago, Ill. App. filed Oct. 23, 1915. Has an electrically operated valve.

1,186,450. Apparatus for Phonographically Recording Telephonically Transmitted Conversations; H. Starke, Cologne, Germany. App. filed May 1, 1912. Can be applied to ordinary telephone station.

1,186,454. Miner's Electric Lamp; A. Toler, Berwind, Col. App. filed April 24, 1915. Prevents possibility of ignition of surrounding gas.

1,186,455. Radiotelephony, Radiotelegraphy, and the Like; W. Torikata, E. Yokoyama and M. Kitamura, of Akita, Sakai and Masajiro, respectively, Japan. App. filed July 18, 1913. Equilibrator and self-starting device for spark gap.

1,186,459. Electric Apparatus for Driving Clocks or Similar Mechanism; H. E. Warren, Ashland, Mass. App. filed Jan. 27, 1911. Attraction and repulsion between permanent magnet and a conductor.

1,186,462. Measured Service Telephone System; B. D. Willis, Chicago, Ill. App. filed Aug. 5, 1910. Connection made either automatically or semi-automatically (thirty-nine claims).

1,186,464. Telephone Exchange System; G. Babcock, Rochester, N. Y. App. filed Feb. 17, 1910. Meter under joint control of subscriber and exchange apparatus.

1,186,471. Trunk Selecting Switch; J. Erickson, Chicago, Ill. App. filed July 7, 1913. Wipers select trunks in both directions.

1,186,473. Automatic Switch; F. Funke, Independence, Mo. App. filed Sept. 17, 1910. Switch cuts out battery when engine reaches certain speed.

1,186,484. Pay Station Telephone System; F. Lubberger, Chicago, Ill. App. filed Oct. 18, 1906. For automatic or semi-automatic.

1,186,516. Typewriting Machine; A. G. Kupetz, New York, N. Y. App. filed Nov. 18, 1913. Carriage return.